SURGICAL NURSING AND AFTER-TREATMENT

SURGICAL NURSING
AND
AFTER-TREATMENT

(DARLING)

ELEVENTH EDITION

BY

[illegible] EDWARD WILSON

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With 361 Illustrations



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THE NIGHTINGALE WING SYDNEY HOSPITAL

Because of her gratitude to the Australian people for their generous contributions Florence Nightingale responded to a request from Sir Henry Parkes and in 1868 sent one of her own nurses Miss Lucy Osburn to be the Lady Superintendent of Sydney Hospital After the plans had been submitted to Florence Nightingale the Nightingale Wing of the Nurses Home was built in 1869 During that year the training of nurses was commenced in Australia

PREFACE TO THE ELEVENTH EDITION

Before the publication of the tenth edition Dr Darling's health began to fail and he decided to hand over to me the authorship of future editions Unfortunately his premonition of not being able to assist with the preparation of the eleventh edition was correct for he died on September 9th 1956

Prior to this edition 60 000 copies have been printed and I feel sure that whether in Australia or abroad those through whose hands all these books have passed will have kind memories of Dr Darling and of the help they received from this little volume

Since the first edition the purpose of this book has always been to describe and explain the various proven nursing procedures used in the care of surgical patients and this purpose has been maintained in the preparation of this eleventh edition In other words emphasis is placed on the practical aspects of surgical nursing This book is not an abbreviated text book on surgery as a whole, it does not contain lengthy descriptions of surgical diseases or of operations nor does it deal with surgical diagnosis Such subjects are all available in the many text books of surgery which however do no more than touch on the details of surgical nursing This book is also not meant to replace the existing books on first aid

The nurse is not intended to be a keen diagnostician of diseases, but rather her duties as part of the team which includes the surgeon, anæsthetist and resident medical officer, are to care for the patients and to observe changes in their conditions A knowledge of the contents of this book will help her to become efficient along such lines At the same time it will help her pass her examinations for the present syllabuses of surgical nursing required by the General Nursing Council for England and Wales by the Nurses Registration Board of N S W, and other examining bodies are fully covered

With the passage of eight years since the last edition it has of course been necessary to make many changes and I feel sure that this new edition will retain the position the book has held for so many years Every effort has been made to keep abreast of the recent advances in surgery and therefore most of the text has been rewritten Special reference has been made to those conditions such as tetanus and ulcerative colitis—to mention only two of them in which the recent changes in treatment greatly affect the nursing care and attention required In addition there are many new sections which include the surgical nursing of patients submitted to operations on the heart lungs œsophagus and adrenal glands

DEDICATED

TO

THE AUSTRALASIAN TRAINED NURSES ASSOCIATION

WHICH HAS DONE SO MUCH TOWARDS THE ADVANCEMENT OF NURSING IN AUSTRALIA

First Edition	H C Rutherford Darling	1917
Second	,,	1923
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Printed in Great Britain

illustrations have been replaced and a large number of new illustrations added In addition a glossary has been included

My sincere thanks are offered to my publishers and to all who have so kindly helped with the preparation of this edition

159 MACQUARIE STREET T I W
SYDNEY, N S W 1959

FROM THE PREFACE TO THE FIRST EDITION

This book deals with only one branch of Nursing—namely Surgical Nursing—and it has been written in accordance with the syllabus laid down for the final examination of the Australasian Trained Nurses Association

I hope that it may prove to be of some assistance not only to young nurses studying for examinations but also to those who have been for some years out of touch with modern hospital surgical nursing

Since an ounce of practice is worth a pound of theory surgical nursing is best learnt by actual experience in a well-equipped and up to-date general hospital but in actual practice there is generally no time to explain the multitudinous details of surgical nursing

In this book an attempt is made to supply the requisite elucidation and to reduce the duties of a nurse to a state of orderly sequence for the best nurse is necessarily one who combines theory and practice Whilst this work is primarily addressed to nurses it is to be hoped that it may also prove to be useful to students and dressers as well as to the junior members of the medical profession

I am most deeply indebted to my publishers who have spared no pains in perfecting the production of the book

H C R D
229 MACQUARIE STREET 1917
SYDNEY N S W

The chapters have been rearranged so that the many sided subject of surgical nursing is gradually, but steadily, developed in an orderly manner

Three new chapters by Dr Gwenifer Bernard D A, F F A R A C S, on the nursing aspects of anæsthesia and on the care of the unconscious patient have been included and in them special consideration is given to the nursing problems that have followed the recent changes in anæsthetic methods

A new chapter by Dr Harold Ham F F R F C R A, D M R E, on the care of patients before and after radiotherapy has also been included

Dr R Bettington has relinquished the chapter on the ear, nose and throat, and a new chapter has been written by Dr Frank Ellis M S D L O F R A C S

Dr A J Flynn has relinquished the chapter on the eye, and this has been completely rewritten

The chapters on diabetes and on bandaging have been omitted

The notes on blood transfusion were prepared with the assistance of Dr John G Gibson of Wellesley Mass Useful advice with the preparation of this edition was given by Dr Douglas Joseph of Sydney Hospital and the following Tutor Sisters Sisters A Fordyce and B F Parker of Sydney Hospital Sister D Lyons of The St George Hospital Kogarah Sister J Mudge of the Royal Prince Alfred Hospital Camperdown Sister H H Harris of the Repatriation General Hospital Concord and especially Sister B Hughes, of the Balmain District Hospital Mrs Pam Wright and Miss Carol Renahan have done the typing and have helped in many ways Mr G H Bruce was of great assistance with the proof reading Dr R Winton Editor of the *Medical Journal of Australia* has given permission for inclusion of quotations from my paper on the treatment of advanced cancer which was published recently in his Journal

Three quarters of the illustrations of the tenth edition have been deleted and replaced by a greater number of new drawings by Mr Roy Fluke of Sydney and of photographs by Mr R A Money of Sydney Hospital In addition various illustrations of surgical instruments and appliances have been made available by the following firms Allen & Hanburys Ltd of London Chas F Thackray of Leeds England The British Oxygen Co Brentford England American Cystoscope Makers Inc New York Davol Rubber Company of P idence 2 Rhode Island U S A Down Bros and Mayer & Phelps Ltd of London The Genito Urinary Mfg Co Ltd of London Salt & Son Ltd Birmingham and London Medical & Industrial Equipment Ltd London John Bell & Croyden and Arnold & Sons London Milton Antiseptics Ltd London Watson Vic Ltd Sydney N S W and Johnson & Johnson Pty Ltd of Syd y N S W As a result of these changes the out of date

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Pathology is the science of disease It is concerned with the reactions of the tissues with the happenings during the course of the disease and with the complications which may develop

Bacteriology is the study of micro organisms particularly the minute organisms known as Bacteria

BACTERIOLOGY

The importance of the study of Bacteriology is twofold namely (1) most diseases are due to the presence in the body of pathogenic or disease producing micro organisms and (2) these organisms are practically universal and will in the absence of suitable precautions, enter any external wound and delay the processes of healing

Micro organisms (microbes germs or bacteria) are invisible except when highly magnified by a microscope and they are then found to be of different sizes and shapes

Bacteria multiply by fission or splitting and each half forms a new small bacterium

Bacteria are divided into two groups which are called Gram positive and Gram negative This classification depends on the reaction to Gram s stain After the organisms on a slide are stained with methyl violet an attempt is made to remove the colour with absolute alcohol Those bacteria which then retain the purple colour are called Gram positive whereas the bacteria that are decolourized by the alcohol are called Gram negative The latter are restained with a dye, neutral red, so that they can be examined

Another division of bacteria into two groups depends on whether or not they are acid fast with Ziehl Neelsen's stain The tubercle bacilli and other acid fast bacilli are difficult to stain but, once stained, they are difficult to decolourize After staining the organisms on a slide in hot carbol fuchsin they are flooded with dilute sulphuric acid This immediately removes the stain from most organisms but it does not decolourize the acid fast bacilli

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CHAPTER I

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Bacteria are further subdivided according to the shape of the organism into —

1 Cocci, in which the micro organisms are globular
2 Bacilli, which are shaped like straight rods
3 Spirilla in which the shape is that of curved or spiral rods
4 Streptothrix, which forms lateral branches The causative oragnism of actinomycosis is a streptothrix

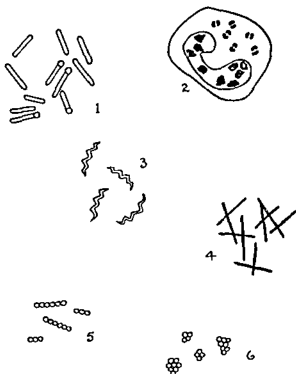


FIG 1 Diagrams of bacteria showing
1 Bacteria some of which contain spores (*B tetani*) 2 A leucocyte containing engulfed gonococci 3 Spirochætes 4 Klebs Loeffler bacilli of diphtheria 5 Streptococci and 6 Staphylococci

5 Spirochætes The spirochæta pallida of syphilis is very thin and is best examined by dark ground illumination *i e* with the light reflected from them but with their background not illuminated

6 Vibrios which are short curved and rod like and of which the cholera vibrio is an example

The unit of length in bacteriology is 1/1 000 of a millimetre and is usually denoted by the Greek letter μ The average diameter for a coccus is 1μ and the average size of a bacillus is $6\mu \times 1\mu$

Thus a finger tip could easily accommodate more than 10 000 000 bacteria without crowding them together When it is remembered that normally every surface is covered with bacteria it will be under stood how certain it is that just a touch will cause contamination

Cocci are round in shape, multiply by fission and never produce spores, they may be further subdivided according to their grouping —

(i) *Diplococci* where the cocci have a tendency to remain grouped in pairs as exemplified by the gonococcus and pneumococcus
(ii) *Tetracocci* where the cocci are grouped in fours
(iii) *Sarcinæ* where the cocci are arranged at each of the corners of a cube and the group resembles the shape of a bale of wool
(iv) *Streptococci* where owing to continued transverse division the cocci are arranged in chains

There are two main groups namely hæmolytic streptococci possessing the power to hæmolyze red blood cells and non hæmolytic which do not possess this property (Fig 2) Using a precipitin test Lancefield subdivided the hæmolytic streptococci into four groups, of which one Group A, is responsible for some infections in man

(v) *Staphylococci* where the cocci are irregularly arranged in groups like bunches of grapes

The cocci are also subdivided into the

(i) Gram positive cocci, which include the
staphylococcus aureus
staphylococcus albus
pneumococcus,
streptococci of various types, and
sarcinæ
(ii) Gram negative cocci, which include the
micrococcus catarrhalis,
meningococcus and
gonococcus

Bacilli are straight rod shaped organisms which are sometimes spore bearing spores are formed when the conditions for bacterial life are unfavourable They are analogous to the seeds in higher plants and are very resistant to drying heat and antiseptics

In view of this resistance it is indeed fortunate that few spore-forming bacilli are harmful to man the chief exceptions being the organisms of tetanus gas gangrene and anthrax

Some bacilli are motile by virtue of fine wavy, thread like appendages called cilia but others are non motile

The bacilli are divided into the

(i) Gram positive bacilli which may be
(A) Spore bearing and include the
(a) Spore bearing ærobes (anthrax bacillus) and
(b) Spore bearing anærobes (the clostridia which include the bacilli of tetanus and of gas gangrene)

(B) Non sporing which include the
corynebacterium diphtheriæ or the Klebs Loeffler bacillus and
diphtheroid bacilli
(ii) Gram negative bacilli, which include the
bacillus coli communis and other coliform bacilli,
whooping cough bacillus (*B pertussis*)
Koch Week s bacillus from the conjunctiva, and
bacillus pyocyaneus from some wounds
(iii) The acid fast bacilli, which include the tubercle bacillus and the leprosy bacillus



Fig 2 Sketch of a dish containing blood agar culture medium (a blood agar plate) on which hæmolytic streptococci are growing The clear zones in the culture medium are due to the hæmolysis of the blood around each colony of streptococci

Fungi are composed of branching filaments which form a mycelium or network Spores are formed by fungi and are their method of reproduction but these spores have very little resistance to heat and antiseptics and thus they differ from the spores of bacilli Ringworm is caused by a fungus

Protozoa omprise a group of extremely small very simply organized unicellular animals the life history of many of them is not known but it has been traced out in some

Both malaria and amœbic dysentery are of protozoal origin

Distribution of Bacteria Bacteria are almost universal in distribution

In air and water the numbers of bacteria vary in direct proportion to their proximity to organic life and also to warmth and hence th are practically absent from the air of mountain tops but are pr in vast numbers in the air of cities

Bacteria, frequently of pathogenic varieties, are always found in abundance in the soil on the earth's surface and consequently in dust, which is thus an important carrier of pathogenic germs

Apart from any actual disease which an animal may have, bacteria are always found in connection with the skin mouth, alimentary canal nose, and the lower parts of certain apertures such as the urethra, vagina, etc

The surface of the skin the hair follicles and sweat glands teem with bacteria

Bacteria are present in the alimentary canal from the mouth to the anus but they are most numerous at the end of the small and the beginning of the large intestine

Physiology of Bacteria For the activity of pathogenic bacteria *i e* bacteria which cause disease in man the necessary conditions are sufficient foodstuffs which the bacteria can use water and a temperature at or about blood heat Since bacteria have no chlorophyll, they require organic protein for food and thus differ from the lowest scale of plant life This protein may be obtained from living animals when the bacterium is known as a *parasite* or conversely from dead tissue, when it is known by the name of saprophyte

Furthermore certain organisms in addition require oxygen *e g* the pyogenic cocci, and these are known as *Aërobes* but others on the contrary cannot live in the presence of oxygen and are styled *Anærobes*

It necessarily follows that the reverse of the above conditions will cause a suspension of bacterial activity or growth

Bacteria may be killed by heat by certain chemical reagents and by contact with living tissues All organisms are quickly killed by heat at boiling point (212° Fahr) but spores require prolonged boiling or a temperature of 250° Fahr to kill them Certain chemical reagents *e g* phenol and acriflavine etc , also known as germicides are fatal to bacterial life but these must be of a certain strength must come in intimate contact with the germ and must be able to act for a certain time Spores are killed in the autoclave

INFECTION

Infection may be defined as the invasion of the living tissues by bacteria in such a manner as to produce local or general disease

Settled in their chosen site the bacteria commence the manufacture of toxins which give rise to local irritation of the tissues with resulting inflammatory reaction

The general or constitutional effects arise from the absorption of these toxins into the blood stream which carries them to other regions of the body producing degeneration of tissues metabolic disturbance etc Thus the chief action of bacteria upon the tissues of the body is chemical in nature

Bacterial infection depends on conditions which may be classified as *those on the side of the germs* and *those on the side of the soil* in which they are growing

The former are three in number —

The Dose of Bacteria Bacteria must be introduced in certain numbers or they will be destroyed before they can produce any effect Victory is on the side of big battalions '

Their Virulence The natural virulence of bacteria varies enormously it may be artificially increased by passage through successive animals or it may be artificially decreased by cultivation outside the body especially under unfavourable conditions



FIG 3 Diagram of a sterile swab stick held in a sterile test tube by a sterile piece of cotton wool The swab stick must be removed without its touching the mouth of the tube

Pathogenicity Only certain kinds of bacteria are capable of producing disease and then only in certain kinds of animals

Conditions on the side of the soil ' are the susceptibility of the host or the vulnerability of his living tissues to bacteria This may be increased by certain constitutional disturbances such as cold, wet starvation alcohol and other narcotics, and by many constitutional diseases such as Bright's disease, diabetes mellitus, etc

INFLAMMATION

Inflammation may be defined as the reaction of tissue to injury

Cause of Inflammation This injury is generally due to some form of *irritant* whether organic or inorganic Irritants may be classified as *Mechanical* such as a blow or an incision *Thermal* such as heat and cold *Electrical* such as lightning or X Rays *Chemical*, such as acids or alkalies and *Bacterial* such as the toxins of many bacteria

Signs of Inflammation The signs of inflammation can be divided into the local and the general or constitutional signs

THE LOCAL SIGNS OF INFLAMMATION commonly called the cardinal signs are Pain redness swelling heat and loss of function

Redness is the result of arteriolar dilatation or hyperæmia If the inflamed part is deeply situated it is invisible but an enlargement of the surface veins then suggests deep hyperæmia

Swelling is due to dilatation of the arterioles of the part and the exudation of inflammatory lymph it will vary in accordance with the amount of hyperæmia and the distensibility of the tissues

Heat results from the increased blood supply it is an invaluable clinical sign as it denotes active and progressive changes

Pain is caused by the tension resulting from the exudation and from the dilatation of the vessels It is increased by pendency of the inflamed part and is relieved by its elevation and the more resisting the structure involved the greater the pain

Loss of Function Owing to the alteration of its tissues and the change in the quantity and character of the blood going to it, the affected part fulfils its functions inefficiently

THE GENERAL OR CONSTITUTIONAL SIGNS OF INFLAMMATION are secondary to the local, they are due to the entrance into the blood of some material produced at the seat of the injury In simple traumatic fever it is probably fibrin ferment produced by the dis integration of leucocytes but in cases of infection substances brought forth directly or indirectly by the bacteria are also absorbed The changes which are produced by the bacterial toxins absorbed into the blood stream may be classified in accordance with the three great systems affected —

Alimentary System Thirst loss of appetite dryness of the mouth and tongue, sordes and constipation

Circulatory System Flushed face, rapid pulse and sweating

Excretory System The urine is scanty, high coloured and highly acid

The results of infection are increased combustion in the body generally which explains the symptoms and the increased production of heat

The Local Changes of Inflammation For the purpose of description these may be divided into the vascular phenomena and the changes occurring in the tissues

VASCULAR CHANGES When an irritant is applied to a living tissue the following changes occur in its vascular system —Hyperæmia, stasis, migration of leucocytes and exudation of inflammatory lymph

Hyperæmia is due to the direct action of the irritant on the vessel wall and is characterized by dilatation of the vessels and an acceleration in the circulation of the blood through them

Stasis Owing to alteration in the vessel wall sooner or later the flow abates and the stream grows slower and slower until it finally ends in stasis or stagnation

Migration of Leucocytes Whilst the foregoing changes in the blood stream are taking place an alteration in the behaviour of the blood cells also occurs The leucocytes or white corpuscles, fall from the axial into the peripheral part of the current and then adhering to the walls of the vessels gradually squeeze through small gaps in the walls (Fig 4) After the emigration of the leucocytes

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TISSUE CHANGES take place somewhat later than the blood changes and, in general the effect of the injury is either to cause (1) destruction or devitalization of the tissues, or (2) an increased proliferation of the cells depending on the intensity of the injury

Destruction of the tissues will be caused by a severe irritant

Proliferation of the cells of the tissue The cells of the tissue enlarge change shape and form subdivisions of their nuclei and protoplasm It is, however, only cells to which a mild injury has been a stimulant that show this activity These new cells at first act as ' phagocytes,' *i e* they seize on any invading micro organisms present or on portions of dead tissue and, taking them into their substance, digest them



FIG 5 Diagrams to show the phagocytosis of a bacterium and its disintegration under the effects of enzymes in a vacuole in a leucocyte In the figure on the left the bacterium is being sur rounded by pseudopodia of the cytoplasm of the cell

Later, these cells tend to produce granulation tissue or ' proud flesh which, in the process of healing forms fibrous or scar tissue (The incidents of repair are discussed in Chapter 6)

Terminations of the Local Phenomena of Inflammation The local signs of inflammation may terminate by four methods —resolution fibrosis suppuration or necrosis and whatever is the structure involved the method is the same in its essentials

RESOLUTION is only possible when the vascular changes have stopped short of thrombosis, the circulation is resumed and the inflammatory exudate is absorbed

FIBROSIS occurs where the new formed cells derived from the pro liferation of the cells of the tissues become organized into fibrous tissue New blood vessels formed by buds from the old vessels run into this tissue to supply it with nourishment

SUPPURATION OR PUS PRODUCTION results when the infection has caused local death of tissue and this is liquefied later by the toxins of the bacteria Two common types may be recognized —(i) Localized = Abscess (ii) Diffused = Cellulitis

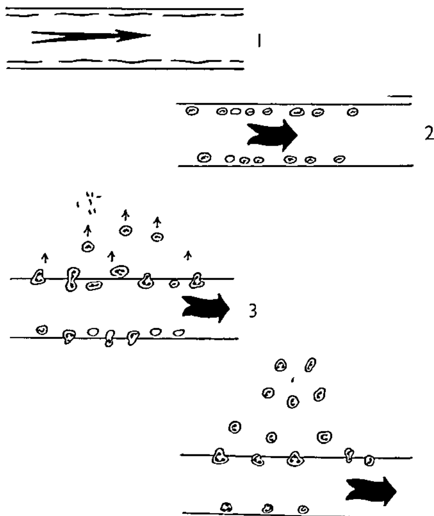


FIG 4 Diagrams showing the changes in a capillary in response to inflammation

1 Normally there is a clear zone without cells at the periphery of the blood stream in the capillaries 2 When the stream slows the white cells (the leucocytes) adhere to the intima of the capillary 3 In a response to a focus of infection or injury the leucocytes migrate through the capillary wall 4 The leucocytes are shown surrounding the inflammatory focus

these cells pass through the tissues to the site of the irritant and the local deposition of fibrin both in tissue spaces and lymphatics shuts off the inflamed area and localizes the infection

Exudation of Fluid At the same time owing to the increased permeability of the vessel wall there is an exudation of fluid into the tissues

These changes namely acceleration of the blood flow migration of cells and fluid exudation are little more than an exaggeration of processes which occur normally in the tissues

GENERAL TREATMENT resolves itself into the general treatment of any febrile condition together with serotherapy, sulphonamides, and the antibiotics such as tetracycline terramycin chloromycetin (chloramphenicol) streptomycin and penicillin By serotherapy we mean the injections of antitoxic sera, antibacterial sera, and the inoculation with modified toxins

By *chemotherapy* we mean the treatment by chemical substances of a disease caused by bacteria

By *antibiosis* we mean the association and antagonism of two organisms to the detriment of one of them

By an *antibiotic* we mean a soluble chemical substance which is derived from a mould or bacterium and which interferes with the growth of another micro organism

Chronic Inflammation Chronic inflammation differs from acute inflammation since the irritant agent is less intense and the local vascular signs are less marked The tissue reaction is usually more prominent the proliferation of cells is more marked and there is usually a large production of fibrous tissue In other words the dominant feature of chronic inflammation is tissue proliferation whilst the vascular changes are less prominent

Treatment In general the principles of treatment are very similar to those employed in acute inflammation The cause should if possible be removed and the part placed at rest In some cases antibiotics and chemotherapy are extremely useful In other cases they are useless and serotherapy may be tried

SUPPURATION

In suppuration bacteria cause the death digestion and liquefaction of large numbers of the migrated leucocytes and cells of the part and thus the inflamed areas are filled with a liquid which is called pus and which contains very many dead and dying cells

Cause The bacteria usually belong to the group of pyogenic or pus producing cocci of which the commonest varieties are the staphylococcus and the streptococcus

The opportunity for these organisms to cause suppuration depends on a debilitated condition of the patient or, locally, on damage and fouling of the tissues of the wound

Pathology In the production of an abscess three definite stages can be recognized and these can best be described in relating the conditions usually found on the first, second and sixth days respectively

STAGE I The usual signs of inflammation can be recognized but owing to the action of the bacterial toxins on the injured tissues their vitality is usually destroyed and a local death of tissue usually ensues in this area

NECROSIS where the infection causes death of tissue *en masse*, may give rise to —

1 *An Ulcer* where loss of tissue occurs on a free surface,

2 *A Slough* where a piece of tissue has been killed *en masse* but not liquefied

3 *Gangrene* or death of tissues in massive quantities

To summarize the hot painful swollen red spot of inflammation may quickly and entirely disappear (resolution) or it may threaten mischief and then subside leaving a permanent firm nodule of fibrous tissue (fibrosis) It may suppurate and form an abscess or a slough may form in its centre Occasionally gangrene of the entire inflamed area may occur as in a carbuncle

Morbid Physiology of Inflammation Inflammation is of benefit to the patient in the following ways —the dilatation of the vessels and the acceleration of the flow not only keeps up the nutrition of the affected tissues but also brings more of the antibacterial and antitoxic substances present in the blood to the part The exudation of inflammatory lymph further aids the latter factor and in addition dilutes any toxin or poison produced by the bacteria The stasis of the blood assists the emigration of the leucocytes which then act as phagocytes attacking and destroying the bacteria

Although human serum possesses the power to kill many micro-organisms some of the most virulent such as streptococci and staphylococci have the power of living or even growing in serum The natural defence against these is the leucocyte but its effect is often greatly aided by the sulphonamides and the antibiotics However, it must be pointed out at this stage that the introduction of the antibiotics and of the sulphonamides has not lessened the importance of careful asepsis

Treatment of Acute Inflammation The treatment of acute inflammation may be divided for descriptive purposes into local and general

LOCAL TREATMENT consists of removing, if possible the exciting cause and applying physiological rest to the inflamed part

The treatment of hyperæmia varies If it is of non bacterial origin an effort should be made to bring about its reduction

This may be carried out by the application of cold to a sprained joint or by the local depletion of blood The latter may be accomplished by elevating the part

On the other hand if it is of bacterial origin an effort should be made to help Nature by increasing the hyperæmia This may be done by the application of heat (*e g* fomentations which relax the blood vessels and give rise to an arterial hyperæmia)

An increased exudation of inflammatory lymph may also be brought about by applying to the wound certain substances which have an attraction for water *e g* strong saline solution, glycerine etc

RIGORS

A rigor is due to the absorption of bacterial poisons or toxins In healthy individuals a rigor usually indicates the onset of an acute illness, *e g* pneumonia or malaria but if occurring during the course of an illness it points to the formation of pus The average period of a rigor is about twenty minutes and it may be repeated at intervals

A rigor can be divided into three stages, in which, as a rule chill, fever and sweat follow each other in orderly sequence

The Cold Stage is due to contraction of the skin blood vessels The patient begins to shiver, the face looks blue and cold and in a fully developed rigor the whole body shakes, the teeth chatter and the shivering is often violent enough to shake the bed The pulse is small and quick and the temperature rapidly rises it may even reach 105° to 106° Fahr

Hot Stage After a variable time the temperature ceases rising and the skin begins to perspire, *i e* the skin blood vessels dilate The patient gradually begins to feel warmer the face becomes flushed the hands congested and the skin red The pulse is rapid and full there is usually headache, and the patient complains of thirst

Sweating Stage The temperature rapidly falls and this fall is accompanied by profuse sweating beads of perspiration appear upon the face and gradually the whole body becomes bathed in profuse perspiration

At the termination of a rigor the patient is generally in a condition of collapse and stimulants may be necessary

Treatment In the cold stage the patient should be well wrapped up in hot blankets and sweating induced by the application of heat and the administration of hot drinks If the temperature reaches a high level the patient may require tepid sponging

During the hot stage care should be taken that the patient does not throw off the blankets and catch a chill

In the last stage sponging may be required to remove the perspiration

STAGE II This area of necrosis and the tissues around it then become liquefied owing to the digestive action of the toxins of the bacteria and of enzymes from the leucocytes The abscess from within outwards then consists of three zones —

(a) A mass of bacteria, dead leucocytes, and partially digested tissues suspended in serum It resembles a fairly thick yellow cream and is slightly viscid and alkaline This is pus

(b) The surrounding living tissues are infiltrated with leucocytes which are actively performing their function of phagocytosis, and thus a wall of leucocytes is formed

(c) Living tissue in a state of hyperæmia

STAGE III The abscess cavity is lined by granulation tissue which consists of a velvety pink membrane (pyogenic membrane) The latter is composed of numerous loops of newly formed blood vessels embedded in a mass of leucocytes and tissue cells in a state of active proliferation and is the first stage in the production of scar tissue The abscess from within outwards then presents —

(i) A central collection of pus
(ii) A wall of leucocytes, and
(iii) A lining membrane of granulation tissue

The subsequent history of an abscess differs according to whether it is opened or left unopened

If it is opened and efficiently drained it heals by second intention The result is that the abscess cavity fills up from the bottom with granulation tissue and finally heals altogether

If the abscess is left unopened it tends to track in the direction of least resistance It thus causes pressure on the blood vessels and in turn this results in death and liquefaction of the tissues lying in front of it This process of extension continues until the abscess points and then it spontaneously bursts through the skin or into the alimentary canal or other cavity

Signs of Acute Suppuration An abscess presents all the classical signs of acute inflammation the only difference being that the pain becomes distinctly throbbing in character Locally there is a red, brawny mass in the centre of which there may be a feeling of elastic resistance owing to the liquefaction of its contents

The general signs of an abscess are those of bacterial infection combined with increased fever sometimes a rigor and leucocytosis or an increased proportion of leucocytes in the blood

Treatment In the early stages suppurative inflammation should be treated in a similar manner to that laid down for the treatment of acute inflammation When the presence of pus is clearly indicated the abscess should be opened the pus evacuated and free drainage established by drainage tubes or gauze and an effort should then be made to aid Nature by increasing the hyperæmia

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CHAPTER 2

IMMUNITY AND NEW GROWTHS

IMMUNITY

SINCE bacteria are not infective to every class of animal it follows that there must be a condition of the body which prevents their growth and the formation of their toxins or poisons Moreover since the majority of cases of bacterial infection recover, the body must become resistant to their growth after a time Also in cases of the same infection in different individuals we find a varying degree of severity of infection *i e* a varying degree of bacterial growth

A patient may therefore show susceptibility or refractoriness towards a disease, and both these qualities may be possessed to a varying extent not only by different races but also by different individuals of the same race

Definition Immunity may be defined as a condition of the body, natural or acquired, rendering it resistant to the invasion of one or more infective disorders

The natural defences of the body against bacterial invasion are three —

1 An unabraded intact and healthy mucous membrane and skin

2 The hydrochloric acid of the gastric juice which is secreted in the stomach and which acts as an antiseptic

3 The natural antagonistic action of certain substances present in the fluids and cells of the body

Morbid Physiology of Immunity The research of recent years into the changes which occur more especially in the blood in immunity has revealed the fact that injection of bacteria and bacterial toxins into the body leads to the formation of substances which are antagonistic to the action of bacteria and their toxins In other words the tissues acquire two methods of defence firstly antibacterial substances are produced and kill the bacteria, and secondly antitoxic substances (antitoxins) are produced and combine with the bacterial toxins and render them inert

This antibacterial action is brought about by the two factors phagocytosis and bacteriolysis

PHAGOCYTOSIS is the phenomenon by which special cells of the body take up living bacteria and digest them the cells which exhibit this phagocytic action include the leucocytes of the blood the cells lining blood and lymph vessels, and certain cells in the spleen lymph glands, etc

The bacterium is engulfed by the cell, and lies in a little bubble in its protoplasm, into which the cell secretes digestive ferment whereby the bacterium is digested (Fig 5)

An opsonin is a body present in the blood, which makes the leucocytes take up more bacteria than if they were free from blood, in other words it acts on the bacteria and prepares them for phagocytosis

BACTERIOLYSIS Antibacterial substances are present in the blood, and these kill and dissolve the bacteria apart from phagocytosis

Bacteriolysis takes some time for production, and in the early stages phagocytosis is the only means of protection

Varieties of Immunity For descriptive purposes immunity may be subdivided into natural and acquired

NATURAL IMMUNITY is that which is inherent in the constitution of an individual when born and is not due to any event taking place in his life history for example, leprosy is a disease peculiar to man and cannot be inoculated into animals as they are immune The nature of this condition is not known but no bactericidal or antitoxic substance can be separated from the blood of an animal exhibiting this phenomenon of natural immunity

It can be lessened by certain constitutional factors, for example cold, wet, starvation, hæmorrhage excessive indulgence in alcohol etc, *i e* this immunity becomes lowered by causes which depreciate the general or local vitality of the body

ACQUIRED IMMUNITY is due to an event taking place in the life history of an animal and can be divided into active and passive immunity

Active Immunity is due to a previous attack of a disease either natural or the result of artificial inoculation so that the animal is freed from the risk of contracting that particular disease again Active immunity may be brought about by acquiring the disease as it occurs in nature or a related disease or by the inoculation of a related organism or its causal organism in a mitigated state

The latter may be carried out in the following ways —

1 By the injection of the living virus in an attenuated form for example in vaccination for smallpox we inoculate the patient with smallpox virus modified by transmission through a cow

2 By the injection of dead bacteria This is used in the preventive inoculation against typhoid fever

3 By the injection of the altered toxin or poison of the bacteria *e g* tetanus toxoid It is mainly used in animals for the production of antitoxins For example when gradually increasing doses of virulent diphtheria toxin are injected into a horse each dose produces some local and constitutional reaction both of which diminish as the treatment continues At the end of a variable time the horse s blood will be found to possess highly immunizing properties

4 By the injection of less virulent forms of the organisms for example, the use of the BCG vaccine in the prophylaxis of tuberculosis (Chapter 5)

Passive Immunity Passive immunity is caused by injecting the serum of the blood of an actively immunized animal but this differs from active immunity in that it only lasts a few months, for instance, in the prophylactic injection of diphtheria antitoxin we inject into the patient a measured quantity of the serum of a horse which has been highly immunized against diphtheria toxin

Practical Application of Immunity The practical applications of immunity are twofold, diagnostic and therapeutic

DIAGNOSTIC For the purpose of diagnosis an investigation may be made of the antibacterial properties of the blood of an infected patient For example an investigation of the antibacterial properties is employed in carrying out Widal s test for the diagnosis of typhoid fever

THERAPEUTIC APPLICATION The therapeutic application is more important and the substances employed fall roughly into three main headings —

Vaccines The general principle is to inject into the infected individual an emulsion of dead or avirulent bacteria in order to stimulate the production of antibacterial substances The vaccine used in a given case may be either autogenous , *i e* prepared from the actual organism infecting the patient or stock which has been previously prepared from the same species of bacteria and stored in the laboratory

Stock vaccines may be prepared from one type of organism or from a mixture of several strains when the vaccine is termed polyvalent In prophylactic treatment a stock vaccine is used but for therapeutic purposes an autogenous vaccine is usually more valuable

Antitoxic Sera Examples of antitoxic sera are those of diphtheria and tetanus The main point in the use of antitoxic sera is that they will only render the toxins inert provided that they are injected before the toxins have combined with and injured the living cells hence the importance of their early administration

Antibacterial Sera Antibacterial sera are obtained from animals immunized by injecting gradually increasing doses of living cultures of a particular bacterium in a similar manner to that used in the preparation of antitoxic sera The main antibacterial serum is that prepared against the bacillus of anthrax but this is only rarely used now

Administration of Bacterial Remedies VACCINES should be injected subcutaneously The favourite sites are between the shoulder blades or into the flanks and the forearm and buttocks are in general to be avoided as the subcutaneous tissue is smaller in amount

Antitoxic serum may be injected subcutaneously or in order to obtain more rapid action it may be given intravenously

Vaccination is usually performed on children under four months of age, and the upper arm is generally the selected site The skin is thoroughly cleansed by soap and water and then mopped over with methylated spirit and dried By means of a capillary tube with a rubber teat on it, a drop of vaccine lymph is placed onto the dried skin which is just punctured a few times through the drop with a sterile needle This area of skin is covered for at least a week with a sterile dressing A dry papule appears, which becomes a vesicle (blister) and subsequently a pustule (pimple), a scab then forms and this finally falls off

Vaccination protects against smallpox, the protection in some cases being absolute and in others relative *i e* although the individual may develop smallpox it runs a mild course and a fatal issue is unlikely

It is a noteworthy fact that the worst arms are the most septic and not thereby the most successfully vaccinated

TUMOURS

Definition The word tumour is often applied to almost any swelling or lump but as a scientific term it may be defined as an abnormal overgrowth of tissue which is not the result of an inflammation

Physiology of a Tumour A tumour consists of cells formed by the multiplication of pre existing cells

Its general outline and the arrangement of its cells distinguish it from normal tissues its nutrition is regulated by conditions within itself rather than by conditions of the body generally Furthermore, it usually fulfils no function for example a tumour resembling the glandular tissue of the breast secretes no milk The more rapidly it grows the more atypical its cells and the sooner it degenerates It may undergo various changes such as fatty calcareous and colloid degenerations ulceration or sloughing or hæmatomata cysts or abscesses may form in its centre

Classification Tumours are classified clinically or anatomically Clinically tumours are divided into Simple (benign or innocent) and Malignant whilst anatomically they may be classified according to their resemblance to some normal tissue embryonic or adult

SIMPLE

1 *Connective Tissue Growths* These simulate fully developed con nective tissue

(i) *Fibroma* (Fibrous connective tissue)
(ii) *Myxoma* (Mucoid connective tissue)
(iii) *Lipoma* (Fatty tissue)
(iv) *Chondroma* (Cartilage)
(v) *Osteoma* (Bone)
(vi) *Myoma* (Muscle)
(vii) *Neuroma* (Nerve)

(viii) *Angioma or Nævus* (Blood vessels)
(ix) *Lymphangioma* (Lymphatic vessels)
(x) *Odontoma* (Teeth)
(xi) *Glioma* (Neuroglial tissue)

2 *Epithelial Tissue Growths*
(a) simulating skin or mucous membrane
(i) *Papilloma*
(*b*) simulating fully developed gland tissue
(i) *Adenoma*

3 *Endothelial Tissue Growths* simulating the lining cells of blood and lymphatic vessels and of serous membranes
(i) *Endothelioma*

MALIGNANT

1 *Connective Tissue Growths* simulating embryonic connective tissue
(i) *Sarcoma*

2 *Epithelial Tissue Growths*
(i) *Epithelioma* (Squamous cell carcinoma)
(ii) *Rodent Ulcer* (Basal cell carcinoma)
(iii) *Carcinoma* which may be
(a) acute or encephaloid
(b) intermediary or scirrhous and
(c) chronic or atrophic

Benign or Simple Tumours

These grow slowly even intermittently consist of fully developed tissue resemble the tissue from which they have arisen and are usually encapsulated by a strong fibrous capsule which shuts them off from the

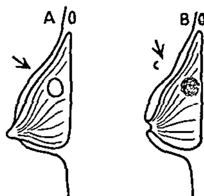


FIG 6 Diagrams to show a cyst in the breast in the left figure and an advanced carcinoma in the right figure A normal lymph gland is indicated by A and a lymph gland containing a metastasis by B

In these diagrams it will be noted that the skin and nipple are normal in the breast containing the cyst but in the presence of an advanced carcinoma the skin is dimpled c and the nipple is retracted

surrounding tissues They neither infiltrate the surrounding tissues nor disseminate themselves through their lymphatics or blood vessels and hence do not recur if fully removed

They do not interfere with health otherwise than mechanically or in so far as they are liable to inflammation and degeneration

Removal is generally advocated for they may grow to a very large size, press on important structures or become malignant

Malignant Tumours

These deviate from the structure of the tissues in which they are situated they grow continuously, often quickly are not encapsuled, and not only tend to invade and infiltrate the surrounding tissues, but small particles are apt to get into the blood and lymph vessels and through these streams tend to reproduce the original tumour or primary growth by secondary growths (metastases) in other parts

It is this power of invasion by infiltration and generalization which gives to malignant tumours their dangerous characteristics

A malignant tumour if left to itself destroys life through the invasion of vital parts by primary or secondary growths or through exhaustion produced by the hæmorrhages and discharges following on infection of the growth

CARCINOMA

Carcinoma has been defined as a malignant tumour arising from epithelium and characterized by a progressive invasion of the adjacent tissues by epithelial cells

It has been shown that a few carcinomata are caused by (a) the presence of a carcinogenic agent in oils and (b) the sex hormones

Although a few cancers in animals are associated with a virus it would appear reasonable to regard carcinoma as being consequent upon chronic irritation or repeated small injuries whereby the tissue cells are persistently called upon to regenerate in order to effect repair As a result of this constant proliferation to repair the damage inflicted the regenerating cells cease to be influenced by the normal balance of power between themselves and adjacent cells with consequent over production and the assumption of malignant characteristics

The chief of the carcinomata in which chronic irritation is an obvious factor are —the smoker s lip chimney sweep s cancer, X ray cancer and Kangri cancer

Carcinoma usually commences as a single local lesion which may be a crack an ulcer a wart or a nodule in the substance of the tissues, and sooner or later it becomes disseminated by means of the lymphatic vessels

It cannot be too strongly emphasized that in the early and favourable stage cancer is usually painless and symptomless and that the

symptoms and signs often described in surgical text books are those of cancer which has progressed past all hope of permanent cure

Earlier diagnosis means more frequent examinations and thus cancer detection centres have arisen These are for the routine examination of people over the age of 40, and it is by such means that there must be an improvement in the results of treating cancers

The so called cancerous cachexia is an indication of the approaching death of the patient and is due to a combination of pain, pressure of the growth on important structures and the absorption of toxic products from the tumour The patient rapidly loses weight, strength and energy and passes into a greatly enfeebled anæmic condition the face is drawn and pinched the skin sallow and earthy looking and the appetite is impaired

SARCOMA

This form of malignant disease of the connective tissues occurs more commonly in young and middle aged people than in the elderly

Like carcinoma it generally begins as a single local lesion but it tends to infiltrate a wider area and hence its complete removal is more difficult The blood vessels of the growth are abundant and so thin walled that, in places, the blood appears to be in direct contact with the cells of the tumour

Its general dissemination is carried out through the veins rather than by the lymphatic vessels

TREATMENT OF CANCER

In favourable cases the growth with its surrounding lymphatic vessels and the whole of the lymphatic area into which it drains may be removed in one mass If this is carried out early and thoroughly a cure may be anticipated

In a few cases with extensive local spread of the growth it is still possible to effect a cure by what is called supraradical surgery This term is used to include both extensions of the commonly used radical operations and also operations such as resection of several viscera *en masse* resections of portion of the lung or liver containing metastases pelvic exenterations (or clearances) and second look procedures (elective re explorations to search for metastases before there is any sign of them)

If eradication of the tumour and of its metastases is not complete recurrence will take place

By the time the patient comes to operation complete removal of the growth is not always possible because of the wide dissemination in the lymphatics of emboli composed of tumour cells In such cases of advanced cancer it is often possible to make the patient more comfortable by palliative operations These are operations which aim at relieving the symptoms but which do not offer any chance of cure For example

a side to side anastomosis may be performed between two loops of bowel to relieve an intestinal obstruction caused by an irremovable carcinoma of the colon

Whenever possible procedures for the relief of severe pain, such as division of nerves intrathecal injection of alcohol and more complicated neurosurgical procedures should all be carried out long before larger doses of opiates are required As a general rule these various procedures are indicated in the care of patients with otherwise intractable pain and with an expectation of life of at least a few weeks when the lesser procedures are employed or of a few months when the more complicated procedures are employed

When complete surgical removal is impracticable various measures may be tried to relieve the patient s suffering These include —

Radiation Therapy The rays given off by radium and X rays are very similar in their therapeutic properties In general, radium therapy is often the method of choice for localized lesions but when a neoplasm is large, widespread and difficult of access, better palliative results will be obtained with X-rays applied by the ' cross fire technique

Diathermy is occasionally employed in the treatment of malignant disease of the buccal cavity, uterine cervix breast and skin

An electric current of high voltage is concentrated upon the growth so that the temperature of the neoplasm becomes raised to the extent of coagulation and destruction Because of its safety and of the relief from pain which it confers diathermy is often used as a palliative measure in cases which are far beyond any hope of cure

Hormone Therapy The hormones at present in use for the treatment of cancer include testosterone oestrogens, ACTH and cortisone

Although testosterone therapy has been widely used in the management of advanced carinoma of the female breast its use is sometimes associated with unpleasant side effects

Oestrogens are of value in most cases of carcinoma of the prostate and in some cases of advanced carcinoma of the female breast when the menopause has occurred more than five years previously

ACTH and cortisone are of value in some cases of Hodgkin s disease lymphosarcoma leuchæmia and carcinoma of the prostate

Castration and Oophorectomy Castration or removal of the testes is used to produce palliation in cases of carcinoma of the prostate and of the male breast Oophorectomy, or removal of the ovaries likewise is used to produce palliation and to delay the rate of growth of some mammary carcinomata

Adrenalectomy and Hypophysectomy See Chapter 21 Adrenalectomy is an operation which has aroused considerable interest in the last few years but its use at present is in the palliation of advanced cases of cancers

In some such cases there is relief from the pain of osseous metastases within the first twenty four hours of this operation Strangely enough the relief of pain is not always accompanied by any detectable regression in the metastases

Patients requiring adrenalectomy are usually not in a fit state to withstand prolongation of the operation and this must be carried out expeditiously

Like castration oophorectomy and adrenalectomy, hypophysectomy (or removal of the pituitary gland) also slows the rate of growth of certain mammary cancers by altering their hormone environment However because of its magnitude, hypophysectomy has only been used in a very restricted group of patients

Local Treatment of Inoperable Cancers

Any ulcerated surface must be kept as clean as possible and free from irritation

A useful but old fashioned local application for a foetid ulcerated carcinoma is acetone or 1 to 2 per cent formaldehyde solution on a piece of lint which is cut to fit the ulcer Zinc cream is smeared over the surrounding skin to protect it against the formaldehyde

General Management of Patients suffering from Inoperable Cancers In cases in which no further surgery or other curative treatment is possible there is still much that may be done for the patient More care and attention rather than less, are then required on the part of his medical and nursing attendants and any tendency to take the easy course and avoid these patients and to spend less time with them should be resisted Even at this stage minor discomforts related or unrelated to the cancer should be efficiently and speedily corrected Lesions such as infections however minor, take on an added importance to the patient who is already suffering from great pain

Throughout the terminal stages it is important that all hope is not taken from the patient While untruths should be avoided it is rarely necessary to tell the patient the whole truth In most cases this is not sought but if so it is better for the patient to ask his doctor as the latter will be more aware of the extent of the growth and its expected progress Under these circumstances the diagnosis should be told without elaborating upon the seriousness of the lesion In some cases it is necessary to reveal the nature of the disease in order to obtain the patient s permission for operation This especially applies to abdo mino perineal resection of the rectum but almost always this pro cedure will be accepted if it is presented as the price to pay for a good chance of cure

Even though it may never be mentioned the presence of cancer will often be assumed by the patient when there is a long drawn out illness This should be remembered in the management of conditions such

diverticulitis and it should be specifically stated that no cancer is present whenever that is certain

Anorexia and reactive depression from prolonged pain are two symptoms which frequently require special care and attention

Occupational therapy has an important place in the management of these patients

The physiotherapist, too by massage and exercises, will be of considerable help in making the patient s days more comfortable and will help prevent the apathy and depression which would cause further deterioration in the condition

The fact that it is no longer possible to offer the patient any chance of cure should not mean the cessation of treatment Even in the terminal stages relief from pain is of course of the utmost importance to the patient

Apart from palliative operations the relief from pain of patients with advanced cancer depends partly on adequate nursing attention together with the use of analgesics and perhaps also of neurosurgical procedures Of the analgesics, the weaker ones such as aspirin, Nembudine, etc, should be used alone whilst they are adequate Narcotics should be used only when relief is not otherwise obtainable It is to be remembered that the stronger narcotics impair the appetite etc

Codeine pethidine morphine or other opiates may eventually be required in increasing amounts No patient should be allowed to die in pain whatever the dosage required, but it should be the smallest which will produce relief and it will be found that if these drugs are combined with the barbiturates the dosage required will be less Largactil and other tranquillizers are a great help in allaying the patient s fears and also in reducing the nausea They also may be combined with one of the narcotics and in fact Largactil with pethidine is often a suitable combination for the patient with severe pain and whose mental condition is relatively unimpaired

The euphoric effect of alcohol should not be overlooked in these patients, and in the terminal stages small doses of Cannabis Indica may be prescribed for the same reason

In conclusion it must be emphasized that the management of patients in whom advanced carcinoma has reached an incurable stage is just as important and just as worthy of attention as that of other patients who are suffering from some so called benign condition such as congestive cardiac failure and who equally obviously have only a short time to live

Reference

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If the toxæmia continues there is a progressive muscular weakness with emaciation diarrhœa secondary anæmia, and cardiac weakness Unless treated the patient ultimately dies of exhaustion Rarely, in such cases, lardaceous degeneration of the smaller arteries occurs

In elderly or debilitated patients severe grades of bacterial toxæmia may give rise to rapid cardiac failure without the evidence of any pyrexia

The effects of bacterial toxæmia may be summarized as —

(1) Fever in which there are the usual signs of pyrexia, *i e* temperature dry tongue quick pulse, scanty urine, headaches etc

(2) The Reaction of the Individual Organs to the Toxins —
- (a) *Alimentary Canal* Diarrhœa and vomiting
- (b) *Nervous System* Delirium and coma
- (c) *Kidneys* Albuminuria

Septicæmia

Definition Septicæmia is a condition in which pathogenic bacteria escape from the local wound into the blood stream and actively multiply there It is a more serious condition than bacterial toxæmia and differs from pyæmia in that there are no secondary abscesses It generally occurs by direct inoculation of suitable organisms through small lesions such as scratches or pricks with infected needles etc and only rarely follows operation wounds or severe lacerated injuries

The streptococcus pyogenes occurs in the blood in about 50 per cent of all cases of septicæmia and in practically all cases of puerperal origin

In most of the other cases of septicæmia pneumococci or staphylo cocci are found

Signs The patient suffers from pyrexia and its accompaniments malaise headache loss of appetite diarrhœa and delirium he is pale and anæmic and the skin may be slightly jaundiced the tongue is brown and parched and the pulse is quick and feeble The tem perature rises to about 104 Fahr and usually remains high It is not intermittent and if recovery occurs its decline is gradual (lysis) Rigors rarely occur unless the illness is complicated by pyæmia

Four manifestations are suggestive of hæmolytic streptococcal infection viz —

(1) diarrhœa
(2) albuminuria with the presence of red blood cells in the urine
(3) rapidly progressive anæmia and
(4) a smooth, red desquamated and sore tongue

To summarize the effects of septicæmia may be classified into two groups —

(1) Pyrexia of a remittant type with its usual accompaniments and

(2) The Reaction of the Individual Organs to Bacterial Invasion

(a) *Alimentary Canal* Diarrhœa (often blood stained) and abdominal distension

(b) *Lungs* Dyspnœa, bronchitis, pneumonia

(c) *Kidneys* Albuminuria or hæmaturia

Prognosis Prior to the introduction of penicillin and the sulphonamides the prognosis in septicæmia was extremely unfavourable most of the cases died in the first week of the disease Since the introduction of these drugs the mortality rate of this disease has been greatly reduced

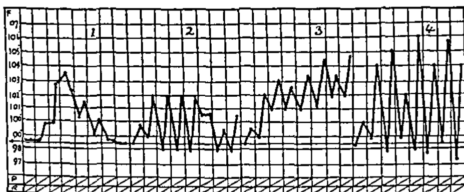


Fig 7 Temperature charts from patients with (1) Sepsis which is responding to treatment (2) Persistent sepsis (3) Septicæmia and (4) Pyæmia

Of the clinical signs in the seriously ill patient a low temperature with a rapid pulse is a much graver sign than a high temperature The same applies to a low leucocyte count for both the low temperature and the low leucocyte count indicate some collapse of the defensive mechanisms of the body

Treatment The local treatment of septicæmia consists in dealing actively with any local acute inflammatory focus either by free incisions and drainage and rarely perhaps even by amputation of a condition such as a suppurative tenosynovitis However it is usually too late for local treatment alone to be of any avail

The fluid intake must be carefully watched, and every attempt must be made to ensure that the intake is such that the output of urine is at least two pints a day Usually an intake of six or more pints will be necessary The fluids should contain dextrose and alkalies during the period of invasion for the heart is severely affected by the toxins and febrile vomiting and acidosis are apt to occur If the vomiting is troublesome or the patient unco operative and the intake of fluids unsatisfactory intravenous injections of glucose and saline will be required

If the toxæmia continues there is a progressive muscular weakness with emaciation, diarrhœa secondary anæmia, and cardiac weakness Unless treated, the patient ultimately dies of exhaustion Rarely in such cases lardaceous degeneration of the smaller arteries occurs

In elderly or debilitated patients severe grades of bacterial toxæmia may give rise to rapid cardiac failure without the evidence of any pyrexia

The effects of bacterial toxæmia may be summarized as —

(1) FEVER in which there are the usual signs of pyrexia, *i e* temperature dry tongue quick pulse, scanty urine headaches etc

(2) THE REACTION OF THE INDIVIDUAL ORGANS TO THE TOXINS —

(a) *Alimentary Canal* Diarrhœa and vomiting
(b) *Nervous System* Delirium and coma
(c) *Kidneys* Albuminuria

Septicæmia

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To summarize the effects of septicæmia may be classified into two groups —

(1) PYREXIA of a remittant type with its usual accompaniments and

a dose of 100 000 to 200,000 units is necessary Several attempts have been made to prolong the effect of penicillin by delaying its absorption by using it in association with procaine, such as is done in the preparation Procaine penicillin G, or by incorporating it in an oily base Distaquaine is an example of the latter It is claimed that a single intramuscular injection of 1 ml of Procaine penicillin G which contains 300 000 units will maintain an adequate blood level of penicillin for 24 hours and that it is only necessary to give such an injection every 24 hours These solutions are difficult to inject through a fine needle and at least a 20 gauge needle should be used These solutions should not be injected into veins and the position of the needle must be checked before making the injection If the plunger of the syringe sticks during the injection it should be withdrawn slightly and then pressure reapplied It has also been suggested that the penicillin be given by a continuous injection into the muscles but penicillin has no action against certain common organisms such as the colon bacillus which are often found on the skin and infection may develop at the site of such injection If a continuous injection is used it is essential that the dressing and the needle are firmly fixed so that the needle is unable to move and so that contamination cannot result from any slipping of the dressing

Because of its rapid excretion the length of time over which penicillin is given is more important than the total dosage used

STREPTOMYCIN Streptomycin is an organic material isolated from an organism (Streptomyces griseus) found in the soil It is effective in some cases of tuberculosis in some cases of B coli infection, and in some other infections Streptomycin is standardized so that 1 gramme contains 1,000 000 units It can be sterilized by heat without loss of activity It is injected intramuscularly dissolved in saline to which may be added ½ to 1 per cent procaine hydrochloride to reduce the pain at the site of the injection In some types of meningitis streptomycin has been given intrathecally that is by injection into the cerebrospinal fluid

In children the dosage of streptomycin is at least 20 000 units per pound of body weight per twenty four hours with a maximum of 1 gramme daily In cases of tuberculous meningitis the intramuscular injections should be continued for three to six months and should be reinforced by intrathecal injection of 50 000 units once daily for at least four weeks

In the adult 1 to 2 grammes of streptomycin may be given daily for several weeks but it is usually stopped after a few days as it is likely to affect the inner ear and cause giddiness

CHLOROMYCETIN OR CHLORAMPHENICOL is a synthetic antibiotic It is useful in some cases of urinary infection and it is effective against a wide range of organisms including the typhoid bacilli It is given

Serum therapy was until recently the best means of treatment of septicæmia In addition to antitoxic serum stock and autogenous vaccines were also used However these have been practically replaced by the sulphonamides penicillin streptomycin and other antibiotics

THE SULPHONAMIDES These include sulphanilamide sulhpapyridine sulphathiazole sulphadiazine sulphamerazine sulphacetamide, sulphadimidine, succinyl sulphathiazole and phthalyl sulphathiazole and are synthetic compounds which are used for the treatment of various infections such as septicæmia, erysipelas pneumonia etc The sulphonamides act by interfering with the use of food substances by the infecting organisms and as a result the defence mechanisms of the body are more able to overcome the infection Sulphonamides are preferably given by mouth every four hours along with sodium bicarbonate but it is sometimes necessary to inject them by the intravenous or intramuscular route The full therapeutic effect should become manifest within forty eight hours and it is seldom advisable to continue medication beyond nine or ten days

During the administration of the sulphonamides the urine should be measured and examined daily and large doses of sulphates and of certain synthetic compounds such as aspirin phenacetin or barbiturates are better avoided Rarely exposure to natural or artificial sunlight results in reactionary skin rashes Common signs of intolerance to these drugs are cyanosis nausea and vomiting pyrexia severe anæmia decreased white cells in the blood, decreased output of urine and a skin eruption resembling rubella The toxic effects especially the effects on the kidneys may be lessened by prescribing small doses of a combination of these drugs Such a combination is Trisulpha

PENICILLIN Penicillin is derived from a mould and its exact nature is still unknown It is effective in a wider variety of infections than the sulphonamides and is non toxic On the other hand it is more expensive and it is usually given by intramuscular injection Penicillin exerts its action by interfering with the reproduction of bacteria in the tissues Unfortunately penicillin is rapidly excreted in the urine and its action only lasts while there is some penicillin in the blood stream Unopened penicillin ampoules may be stored for at least 12 months in a cool place The penicillin powder is dissolved in the appropriate volume of sterile water just prior to the injection Occasionally penicillin causes an urticaria

The usual dose of penicillin for an adult is from 15 000 up to 500 000 units dissolved in sterile water but to produce its full effect this has to be given regularly Doubling the dose of penicillin does not double the time that the penicillin persists in the blood If it is desired to reduce the frequency of the injections to every six hours

discharged into the circulation These infected emboli lodge in distant parts and give rise to infarcts and abscesses

The organisms commonly found in the emboli and in the abscesses are identical with those found in the blood in cases of septicæmia, that is, they are mainly streptococci pneumococci and staphylococci

Signs of Pyæmia The disease is ushered in with a rigor of unusual severity which usually recurs with a sort of irregular periodicity, most frequently at intervals of twenty four to forty eight hours, and they probably correspond to the liberation of emboli These rigors are very severe and are usually followed by profuse sweating After about three or four days pyæmic abscesses develop These are most numerous in the lung where they may vary in size from a pin s head to a walnut and they are characterized by a rapid insidious and comparatively painless development

In the early stages of the disease the patient may appear and feel quite well *i e* after the rigor has passed off but within a few days the con stitutional signs become well marked The tongue is dry and brownish the breath has a curious sweet hay like smell the skin is hot and dull earthy in colour and may show bloodstained rashes, and eventually signs of grave depression supervene and the patient rapidly wastes

Without treatment the prognosis of pyæmia is extremely bad and in typical cases the patients usually die in about fourteen days

For the purposes of description these signs may be classified in a similar way to those of septicæmia into —

(1) PYREXIA of an intermittent type associated with periodic rigors of extreme severity which are supposed to coincide with the liberation of septic emboli

(2) THE REACTION OF THE INDIVIDUAL ORGANS TO THE BACTERIAL TOXINS

Alimentary Canal Diarrhœa and Vomiting

Nervous System Delirium

Kidneys Albuminuria

EMBOLIC SIGNS The effects of the lodgment of an embolus differ according to the organ affected and according to whether the capillary anastomosis of the obstructed artery is abundant or not if the embolus blocks a *main nutrient* artery with poor capillary anastomosis an infarct is produced

The effects of infected emboli in the several organs will be —

Lung Fatal results follow the obstruction of the main pulmonary artery but if only one of the small branches is blocked a certain amount of pain dyspnœa and shock are produced In the latter cases the formation of an infarct is indicated by cough hæmoptysis and pleural pain and this usually leads to a localized patch of pneumonia which in turn is often followed by abscess or gangrene of the lung

Kidney A sudden pain in the loin followed by temporary

by mouth in 250 mg capsules Occasionally, the use of chloromycetin is followed by anæmia nausea or looseness of the bowels

Chloromycetin is also available in a form suitable for intramuscular injection for use in cases in which penicillin and streptomycin cannot be given and it is not possible to give capsules by mouth

Pyæmia

Definition Pyæmia has been defined as a disease arising from the diffusion of pyogenic material in the blood, and characterized by fever of an intermittent type associated with the formation of multiple abscesses in different parts of the body

In connexion with pyæmia the following terms are used —

Thrombosis a coagulation of the blood within the vessels, *Thrombus*, the clot, *Embolism* transportation by the circulating blood of a solid

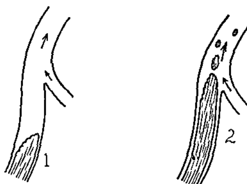


FIG 8 (1) Diagram showing the formation of a thrombus (clot) in a blood vessel The arrows indicate the flow of blood from a tributary into the vessel containing the thrombus (2) Diagram showing the extension of the thrombus so that portions of it (emboli) are broken off and carried down the main vessel by the blood entering it from the tributary

substance into a blood vessel too small to let it pass *Embolus* the substance impacted *Infarction* the necrotic changes which occur in an area deprived of its arterial supply by the blocking of its nutrient artery *e g* by an embolus *Infarct* the area so altered

Pyæmia is usually associated with an infected thrombosis at the seat of infection and is especially liable to follow septic invasion of the venous sinuses of the skull or of the limb bones or of the uterus

As a result of the extension of the suppurative inflammation a thrombus forms in an adjacent vein and this later becomes more or less disintegrated owing to the multiplication of the contained pyogenic cocci The central parts of the clot break down into a fluid resembling pus in appearance and this fluid and portions of the clot may be

REGIONAL INFECTION

Erysipelas

Definition Erysipelas may be defined as an acute spreading inflammation of the skin by the streptococcus pyogenes This organism gains entry through an abrasion which in those cases styled idiopathic , is so minute that it cannot be found

Signs The wound is dry, yellowish, and unhealthy, and is surrounded by a well defined raised patch of rosy red, glossy, swollen skin which gives the sensation of stiffness and burning The area is well defined and the palpable raised edge where the disease is progressing, is very tender to the touch The rash continues to advance more or less rapidly and as it spreads centrifugally the central parts fade leaving a brownish stain covered with fine branny desquamation

When the rash invades parts where the subcutaneous tissue is loose *e g* the eyelids, scrotum etc it gives rise to considerable œdema and if it spreads to involve mucous membranes such as those of the mouth and throat, it generally leads to difficulty in breathing and swallowing

The constitutional symptoms are due to the absorption of the bacterial toxins produced locally, the disease is ushered in with a chill headache general malaise and vomiting The patient then becomes obviously ill, has a temperature of 103° to 104° Fahr a full bounding pulse and suffers from active noisy delirium Erysipelas is usually accompanied by lymphadenitis in the nearest set of lymphatic glands and occasionally phlebitis leading to pyæmia occurs

The disease has an incubation period of one or two days and after a period of about one to three weeks resolution occurs and the patient recovers

Treatment In certain countries for example Great Britain erysipelas is a notifiable disease and the patient must be efficiently isolated and removed if possible to a special ward Every precaution must be taken against conveying infection to other patients The nurse must on no account attend to other surgical or gynæcological cases and she must be scrupulously careful about cleansing and disinfecting any instruments or utensils that may have been used by or for such a case rubber gloves must be worn whilst dressing the wound all dressings should be burnt immediately after use and the bed and linen disinfected at the end of the case

Many and various local applications have been employed in the past for erysipelas but owing to the rapid response to the sulphonamides and to penicillin these local applications are little used now When the pain is severe fomentations containing belladonna or opium may be applied to the rash with relief Until the disease

hæmaturia constitute the main signs of infarction of the kidney This is usually followed by the formation of an abscess

Spleen A splenic infarct is indicated by a sudden pain under the left costal margin and enlargement of the spleen, it is very likely to be followed by abscess formation

Intestines A small embolus gives rise to a localized ulceration as is shown by bloodstained diarrhœa but on the other hand a large embolus usually leads to acute intestinal obstruction due to localized gangrene of the intestine

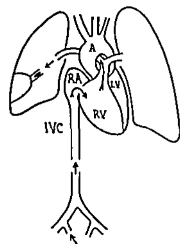


FIG 9 To show the course of a pulmonary embolus which has arisen in a pelvic vein and which has lodged in a terminal branch of the right pulmonary artery The stippled area represents a patch of consolidation in the lung

A Aorta *IVC* Inferior vena cava *LV* Left ventricle *RA* Right auricle and *RV* Right ventricle

Brain Embolism usually results in paralysis generally a hemiplegia and it is often followed by the development of meningitis or a cerebral abscess

Joints Joints are not infrequently involved in pyæmia and may fill with pus

Skin Embolism of the cutaneous vessels generally becomes manifest by the production of hæmorrhagic rashes

Embolism of the Main Artery of a Limb Sudden pain is felt at the site of impaction of the embolus and according to the degree of anastomosis with the neighbouring arteries, gangrene or œdema ensues

Treatment of Pyæmia The local treatment consists in dealing actively with the primary wound either by free incision and drainage or rarely even by amputation

If the primary thrombus can be cut off from the larger veins *e g* by ligating the emergent veins further infection can be prevented and recovery may follow from an apparently desperate illness Ligation of the internal jugular vein may be performed to prevent infected emboli passing into the general circulation from a mastoid infection In most situations however it is not possible to perform such ligation and reliance has to be placed on general methods of treatment

Serum therapy has been replaced by the newer chemotherapeutic and antibiotic drugs

The general health must be supported by a nourishing and stimulating diet such as strong soups beef extracts eggs alcohol etc and copious fluids should be given to dilute and aid the excretion of the bacterial toxins If the patient is unable to drink sufficient fluids intravenous infusion of fluids will be required

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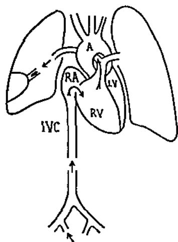


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Signs The local signs depend on the virulence of the organisms and the degree of inflammation may vary from slight redness to widespread suppuration In a case of average severity a diffuse, boggy tender, infiltrated swelling of the subcutaneous tissues occurs, which is covered by red and œdematous skin and the pain is usually severe and of a throbbing character

The general or constitutional symptoms are often severe and consist of a greater or less degree of pyrexia associated with repeated rigors

Treatment The local treatment of lymphangitis or cellulitis consists in elevation of the limb, of the induction of hyperæmia and of abstention from incisions unless suppuration supervenes The local reparative activity of the tissues is aided greatly by resting both the part and the whole body

Suitable chemotherapeutic drugs or antibiotics are given an adequate fluid intake is maintained and the patient s general health is supported by a nourishing and stimulating diet

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Acute Lymphangitis

Definition Acute Lymphangitis is acute inflammation of the lymphatics produced by pyogenic cocci usually streptococci Infection occurs through a break in the skin which may be obviously infected, or like the site of entry in idiopathic cases of erysipelas it cannot be found

The process is usually limited by the nearest set of lymphatic glands which arrest the bacteria with or without the occurrence of suppurating inflammation but occasionally bacteria pass through the lymph glands and give rise to septicæmia

Signs The inflamed lymphatic plexuses are marked out as an irregular patch of diffuse superficial redness from which the inflamed lymphatic trunks are seen as red and tender streaks running up to the nearest lymphatic glands Localized foci of suppuration may occur along the course of the main lymphatic trunks The local symptoms are pain heat and throbbing in the inflamed part which is very tender to pressure the general or constitutional signs may be slight or very severe and are practically identical with those occurring in erysipelas or cellulitis

Treatment The treatment of acute lymphangitis is similar to that of acute cellulitis

Cellulitis

Definition Cellulitis may be defined as a spreading inflammation of subcutaneous or intermuscular tissue it is due to pyogenic organisms commonly streptococci and staphylococci and usually runs on to suppuration Occasionally it leads to sloughing of the tissues The infection occurs through the skin and as in the case of lymphangitis an obviously infected wound may be present or it may be so minute as not to be apparent The infection then spreads through the cellular tissue spaces whose meshes become infiltrated with pus

The fat and cellular tissue become very œdematous the blood vessels are engorged and dilated and on incising the inflamed tissues free hæmorrhage ensues A certain degree of lymphangitis usually accompanies the cellulitis and the lymphatic glands above the seat of infection become inflamed enlarged and tender

Wherever much loose cellular tissue is present cellulitis may readily supervene by the spread of inflammation from the neighbouring structures such as pelvic cellulitis from a septic uterus cellulitis of the upper part of the neck (Ludwig s angina) from a septic throat and cellulitis of the scalp or orbit from a septic scalp or orbital wound

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CHAPTER 4

ULCERATION AND GANGRENE

ULCERATION

Definition An ulcer is a superficial loss of tissue, involving a portion of the skin or mucous membrane

Classification Ulcers may be classified according to their cause into —

1 TRAUMATIC due to the application of an irritant, whether mechanical thermal electrical or chemical of such an intensity as to cause destruction of the tissue

A traumatic ulcer may result from wounds or abrasions or from burns produced by caustics heat or X rays

2 NON SPECIFIC ULCERS *i e* ulcers produced by inflammation due to the ordinary pyogenic organisms

Pyogenic organisms on a free surface are easily removed and owing to the free drainage, there is an absence of tissue tension Thus non specific ulcers usually heal rapidly but if some predisposing cause is present they become chronic and resistant to treatment Such predisposing factors may be either imperfect local treatment or certain constitutional disorders which interfere with nutrition of the part for example passive congestion absence of rest diseases affecting the quality or quantity of the blood or degenerative changes in the nerves hence the terms congestive ulcer trophic ulcer, etc, may be applied to them

3 SPECIFIC ULCERS such as tuberculous lupoid or syphilitic

The process is as a rule very similar to that wrought by pyogenic organisms The original tissues are first infiltrated by cells produced by the specific inflammation and then these destroy and replace the tissues, the new cells perish in their turn and are thrown off superficially and a progressive destruction of tissue takes place

4 MALIGNANT ULCERS occur where the skin or mucous membrane is replaced by a growth which then breaks down by ulceration for example, rodent ulcers and epitheliomatous ulcers etc

Stages of Non specific Ulcers 1 STAGE OF EXTENSION A spreading ulcer is attended by the signs of inflammation and its base corresponds in structure to the wall of an acute abscess

A spreading ulcer is painful has a copious thin sanious offensive discharge the surrounding skin is acutely inflamed infiltrated and œdematous its edge is sharply cut and well defined, and its surface

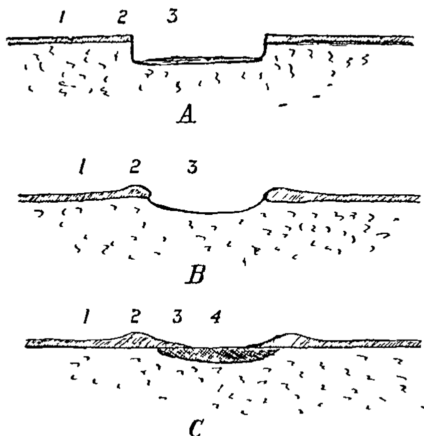


FIG 10 Diagrammatic sections of non specific ulcers

A Stage of Extension 1 Acutely inflamed margin 2 Sharp cut edge 3 Surface covered with slough *B Chronic Stage* 1 Congested margin 2 Thick round elevated edge 3 Smooth glazed surface *C Healing Stage* 1 Normal skin 2 Heaped up sodden epithelium (white ring) 3 Thin advancing layer of epithelium (blue ring) 4 Surface covered with pink granulations

is covered with dirty yellow material, partly slough partly lymph partly breaking down tissue but there is no granulation tissue present

2 TRANSITIONAL STAGE This is the stage between tissue necrosis (sloughing) and tissue formation (granulation) Theoretically every ulcer undergoes this stage but only in chronic ulcers is it well marked In healthy ulcers tissue regeneration begins directly necrosis is at an end

A chronic ulcer has a scanty serous or purulent discharge the surrounding skin is congested and œdematous often pigmented the edges are thick round and elevated covered by heaped up sodden cuticle and its surface is glazed and shiny of a dirty greenish colour

3 STAGE OF HEALING OR REPAIR This stage exemplifies the process of healing by granulation or secondary intention

The ulcer is then painless the surrounding skin is healthy there is little discharge and the edges of the ulcer are shelving The new

epithelium grows as a blue edge across the surface of the ulcer which is covered with red granulations

The differences between the stages of an ulcer are —

	Stage of Extension	Chronic Stage	Healing Stage
Surface	Covered with dirty yellow sloughing material	Smooth greenish glazed and shiny	Covered with small red granulations
Discharge	Copious thin sanious offensive	Scanty serous or purulent	Scanty
Edge	Sharply cut and well defined	Covered by white sodden epithelium	Shelving
Margins	Acutely inflamed infiltrated and œdematous	Congested and œdematous often pigmented not inflamed	Blue ring by epithelium growing in

Treatment of Ulcers STAGE OF EXTENSION Such an ulcer is treated in accordance with the general lines laid down for septic wounds

(a) *Posture* For ulcers of the lower extremities rest in bed with elevation of the foot is especially indicated and this may be accomplished by means of a pillow bed cradle or other appliance

(b) *Establish free drainage* The infective material may then readily escape from the ulcerated surface

(c) *Increase the vascularity of the part* Heat is applied locally in the form of hot fomentations warm antiseptic baths lamps, etc

(d) *Keep up the patient s general health* Feed him on a nutritious diet and attend to any constitutional disturbance

CHRONIC STAGE In this stage four points claim attention —

(a) *Posture* In any case of ulcer of a limb the venous return from the part should be assisted as much as possible by elevating the limb When this cannot be done the best substitute is pressure, *i e* the limb should be firmly bandaged from the toes to a point well above the situation of the ulcer

In the ambulatory treatment of ulcers a crepe or elastic bandage, Elastoplast bandage or Unna s casing may be applied to the leg

A crepe bandage should be put on first thing in the morning before getting out of bed with no creases in the material and sufficiently firmly to prevent its slipping down it should be worn all day and removed after getting into bed at night

(b) *Clean up the Ulcer* This aims at encouraging a healthy reaction so that fresh active granulations may form and be covered by the epithelium growing in from the periphery This may be accomplished by the use of applications such as boric fomentations To prevent reinfection the skin in the neighbourhood of the ulcer is purified in much the same manner as the skin of a region prior to operation

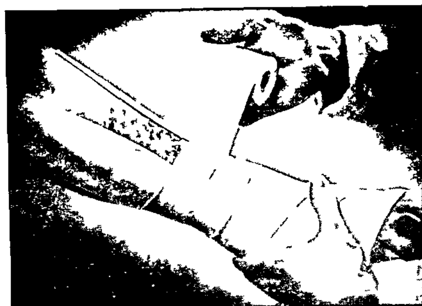


FIG 11 Application of Elastoplast in the ambulatory treatment of a chronic (varicose) ulcer

(c) *Protect the Ulcer and Stimulate the Epithelium* When the ulcer is sluggish or indolent a healthy reaction may be encouraged by the use of stimulating ointments such as scarlet red ointment (4 per cent) or of Lotio Rubra (Red lotion) If an ointment or Red lotion is used it should be applied on lint cut to the shape but rather smaller than the ulcer

Unna s paste is one of the most useful routine treatments for leg ulcers and combines uniform pressure with the application of a stimulating medicament See Chapter 30

When a large surface has been destroyed by ulceration healing may be expedited by skin grafting

(d) *Correct any Constitutional Disturbance* anæmia for example

HEALING ULCER The treatment here resolves itself into —

(a) *Posture* The limb should where possible, be kept elevated and at rest until healing has taken place

(b) *Protect the Ulcer* A simple dressing such as Porowax which can be removed without damaging the newly formed granulations or epithelium should be applied This is covered by a thick pad of sterile or antiseptic gauze which in turn is covered by a layer of absorbent wool and a bandage

It is unnecessary to change this dressing frequently and provided there is no discomfort discharge or bad odour, it may be left on for a few days Gentle pressure helps keep the granulations flat and thus allows the epithelium to grow unchecked and uninjured over the surface of the ulcer

Exuberant granulations should if necessary be treated by the application of silver nitrate or copper sulphate

Elastoplast Adhesive

The ambulatory treatment of chronic ulcers not only rapidly restores a comfortable function to the affected limb but considerably shortens the period of healing The raised leg is firmly and evenly encased in a three inch spiral bandage of Elastoplast which consists of an elastic fabric coated with an adhesive material (Dickson Wright)

The skin should be shaved and cleaned with spirit, excess secretions removed, penicillin and sulphonamide powder applied to the surface of the ulcer and the bandage firmly applied from below upwards, beginning as a spica round the ankle

To prevent any tendency for the bandage to " creep,' two nine inch longitudinal strips of the same material may be laid on the sides of the leg above the ankle and the spiral applied over them

The spiral bandage extends from the roots of the toes to just below the knee and must directly cover the ulcer which has been previously cleaned In painful cases powdered acetyl salicylic acid may be applied to the surface of the ulcer

Discharge may seep through the bandage and should be washed off with soap and water The Elastoplast is left on five or seven days at first, according to the amount of discharge but later may only require renewal every fortnight

The patients are encouraged to go about their work during the whole of the treatment and, although the initial bandage may feel uncomfortably tight an adjustment soon occurs as the affected leg is emptied of the œdema fluid

BEDSORES

Definition A bedsore is an ulcer due to necrosis of the skin and subjacent tissues produced by continued pressure and usually assisted by moisture and bacterial infection

Varieties Bedsores may be subdivided into (i) trophic, and (ii) postural varieties

Trophic or Acute Bedsores These arise owing to trophic disturbances in patients suffering from injuries or diseases of the nervous system The sores are usually acute in their origin and tend to rapidly extend both in area and depth by destroying muscles etc , and may even lay bare the bones

Although these trophic bedsores usually occur in situations subjected to pressure they may develop in places far removed from any source of pressure owing to the vasomotor sensory and trophic disturbances produced by the nerve lesion

POSTURAL BEDSORES These are prone to occur in patients, especially the infirm and those suffering from exhausting diseases, who are kept for a long time in a recumbent position They develop in positions subjected to continual pressure, such as the sacrum, buttocks, great trochanters heels, and elbows, because these bony prominences by constantly pressing on the tissues over them, prevent the proper circulation of blood

Causation Bedsores may occasionally arise in spite of the greatest precautions *e g* in paraplegic cases, but they are usually preventable, and should rarely occur when proper trained nursing is obtainable The causes of bedsores may be described as pressure, moisture and debility

PRESSURE In the situations mentioned above there is but little fat and muscle between the skin and the bony prominences and owing to the arrest of circulation necrosis ensues with the subsequent formation of an ulcer All wrinkles or rucks in the patient s nightdress and undersheet are to be avoided as they increase the pressure on special areas of skin and tend especially in paraplegic cases to produce bedsores If the patient is helpless, his or her position must be changed frequently

MOISTURE When the skin is subjected to pressure the greatest care must be taken to keep it as dry as possible, for urine fæces etc often play an important part in the formation of bedsores by producing a sodden condition of the skin whereby its vitality and resistance to infection is lowered

Signs The progress of bedsores may be described by the words redness abrasion and slough

REDNESS In the early stages the skin becomes dusky red (which does not disappear on pressure) and feels thicker than normal

ABRASION Ulceration soon occurs and the epidermis disappears leaving a raw surface

SLOUGH If urine fæces, etc contaminate the abrasion infection occurs the skin becomes gangrenous and a slough eventually separates leaving a clean cut ulcer

Treatment As stated above a bedsore is occasionally unavoidable, but good nursing will limit the mischief to the part pressed upon whilst indifferent nursing allows bacterial infection to occur and a rapidly spreading sore results

PREVENTIVE TREATMENT The most scrupulous attention must be paid to parts exposed to pressure, especially regarding the avoidance of continual pressure and the cleanliness of the part

Avoidance of Pressure The patient should be on a firm smooth mattress and his position frequently varied in order to change the pressure on a particular part As already mentioned all wrinkles in the night-clothes and undersheet are to be avoided as they only increase

the pressure on the skin In debilitated and paralyzed patients pressure points ' are protected by rings of cotton wool or rubber When bedsores occur the pressure must be relieved by placing a ring shaped air or water cushion under this area so that it no longer touches the bed

In all cases of spinal disease or injury the patient should be nursed on a sponge rubber mattress

Cleanliness of the Parts As a routine in all patients the skin of the back should be examined daily thoroughly washed with soap and warm water at least twice a day, carefully dried with a towel and then rubbed with a suitable application such as methylated spirits It must be remembered that alcohol is not a specific as regards the prevention of bedsores The parts should then be dusted over with some suitable antiseptic powder such as boric acid bismuth subgallate or a mixture of equal parts of zinc oxide and starch

Instead of soap and water and methylated spirits an emulsion of olive oil and a detergent may be used on the skin of the back

If the patient is perspiring freely the sheet and drawsheet must be frequently changed to prevent decomposition of the sweat and the drawsheet must be at once changed if it becomes damp from urine or other fluids If incontinence of urine is present various devices must be employed to catch the urine but in addition the bedding will usually need constant attention

In these cases greasy applications to the skin are to be recommended such as equal parts of zinc oxide ointment and castor oil or one part of zinc oxide two parts of starch and sufficient glycerine to make a thick cream

When the skin though unbroken becomes red and angry it has been recommended to paint it with equal parts of tincture of catechu and liquor plumbi subacetatis silver nitrate solution (1 3 grammes to the ounce) or preferably a 2½ per cent solution of tannic acid

Curative Treatment When a bedsore has formed all pressure must be avoided the ulcer kept aseptic and dressed with suitable stimulating ointments

Avoidance of Pressure The sore must be protected from pressure by turning the patient on his side or by means of rings of rubber or cotton wool

Assiduous Attention to Cleanliness The sore should be kept scrupulously clean by frequently washing it with a weak antiseptic such as peroxide of hydrogen carefully drying it and then applying a suitable dressing Strong antiseptics are harmful and are to be avoided

Local Applications The floor of the ulcer should be swabbed and the sensitivity of the organisms to the various antibiotics should be determined A solution of the appropriate antibiotic in saline is then

applied daily and the wound sealed off Corset type dressings should not be used unless the surrounding skin will not take frequent changes of the adhesive strapping

Stimulating Ointments The ulcer should be kept dry and frequently dressed with stimulating ointments such as zinc oxide ointment with one part in five of tinct benz co or tragacanth paste which contains

Benzoic acid	2 0 g
Glycerine	100 0 ml
Tragacanth powder	100 0 g
Ringer s solution to make	1000 0 g

In some cases success will be obtained by filling the crater of the ulcer with tragacanth paste and covering it with a piece of waterproof cellophane kept in place by adhesive strapping

Every effort must be made to improve the patient s general condition by an attractive high caloric high protein diet and if necessary by transfusion

GANGRENE

Definition Gangrene may be defined as necrosis of the tissues *en masse* but it is especially applied to a necrotic process involving simultaneously the soft and hard tissues for example of a finger toe, or part of a limb etc If the process is limited to the soft tissues it is termed sloughing and the necrotic mass a slough whilst on the other hand if a piece of bone dies the dead bone is called a sequestrum

Causation Gangrene signifies death of a visible portion of tissue and whatever arrests its circulation or kills its cells may be a cause of gangrene

INFECTION In gas gangrene, which is due to infection with the spore bearing anærobic Gram positive bacilli called clostridium Welchii the infection is so virulent that the inflammation ends in necrosis of the tissues attacked

The inflammation acts by lowering the vitality of the tissues and by interfering with their blood supply owing to the pressure of the exudate and the coagulation in the capillaries The distinguishing features of infective gangrene are its tendency to spread independently of the vascular supply of the part and the severe constitutional disturbance produced

Other examples of infective gangrene are hospital gangrene and cancrum oris

OBSTRUCTION OF THE ARTERIES OR VEINS Dry gangrene usually occurs in association with endarteritis or narrowing of the calibre of an artery such as takes place in Raynaud s disease arteriosclerosis diabetes mellitus chronic ergot poisoning etc

On the other hand moist gangrene is produced when dry gangrene becomes infected and in cases where there is mechanical obstruction of the venous as well as of the arterial circulation

PHYSICAL AND CHEMICAL AGENCIES These include gangrene from mechanical causes, such as severe crushes, or from chemical or physical agents, such as caustics, burns or frost bite

Varieties of Gangrene

1 DRY GANGRENE The affected part is at first pale and waxy in colour and then becomes shrivelled, hard black and dry (mummified) and usually emits a peculiar musty odour

Dry gangrene spreads very slowly for, owing to its dryness putrefactive changes, due to the invasion of bacteria are rendered almost impossible

2 MOIST GANGRENE The necrotic tissues are at first swollen and purple then become mottled and finally exhibit a play of colours ranging between dark red purple and greenish black blebs containing bloodstained serum develop beneath the epidermis the epidermis when touched moves on the moist slippery necrotic tissues and on separating exposes a slimy, soft gangrenous mass

If the return of the venous circulation is favoured by elevation of the part the evaporation of fluid promoted the part kept surgically clean and micro organisms excluded the area of aseptic moist gangrene may be partially or totally converted into one of dry gangrene

On the other hand if saprophytic micro organisms gain access to the tissues putrefactive changes will develop, and will give rise to the condition of septic moist gangrene

This infection of the dead tissues with saprophytic bacteria practically always occurs from the skin

Signs of Gangrene The cessation of the circulation is followed by loss of pulsation in the arteries loss of heat loss of sensation loss of function and certain changes in the colour of the part and these are the characteristic signs of local death

With the development of gangrene pain and toxæmia become prominent symptoms and lead to loss of sleep and gradual exhaustion This toxæmia is especially marked in cases of septic moist gangrene The patient presents all the signs of septic intoxication and death may ensue

In dry gangrene glycosuria (sugar in the urine) of a mild degree may develop but this should not be mistaken for the glycosuria of diabetes mellitus as it may be merely due to the absorption of toxic products from the dead tissues

Line of Separation In both dry and moist gangrene the dead part acts as an irritant to the living tissues immediately in contact with it and a line of inflammatory reaction commences at the junction of the living with the dead tissues

This inflammation leads to the formation of a line of demarcation and progresses to the stage of granulation The proteolytic action

of the leucocytes and bacteria leads to cell necrosis, liquefaction and suppuration and a 'line of separation' is produced Firstly, the skin separates, then the deeper parts, muscles and nerves, and finally the bone

In other words this line of separation gradually deepens until separation of the dead tissues is complete when an ulcer is left to heal by granulation

As the line of demarcation depends on the inflammatory reaction in the surrounding tissue, it will be very much better marked in septic moist gangrene than in dry gangrene

Clinically, one observes a red line of hyperaemia at the edge of the living tissues and these gradually become separated from the dead tissues by a narrow white or yellow line due to a layer of inflammatory exudate

This process of separation may occupy many weeks and during that time there is the danger of septic infection of the wound and absorption from it

Treatment The general principles of treatment are clearly defined and the following include the main essentials

Render the Part Aseptic In every case the skin should be shaved and then purified by means of iodine solution The limb is then powdered with penicillin and sulphonamide powder strips of boric lint are placed between the digits and the whole limb enveloped in a voluminous dressing of dry sterilized gauze and wool

Elevate the Part In order to avoid moist gangrene the limb should be elevated to favour the return of venous blood

Keep the Part Dry The part must be kept dry and covered with dry sterilized dressings with all aseptic care Where possible evaporation should be encouraged and warmth may be maintained

Support the Patient's Strength The patient's strength should be maintained by nutritious food stimulants tonics etc Where necessary opium preparations in sufficient doses to secure relief from pain and insomnia should be given

The surgical treatment of gangrene is operative but if left to Nature complete separation will eventually occur

CHAPTER 5

SPECIFIC INFECTIVE DISEASES

A SPECIFIC infective disease is one that is produced by a single cause *i e* one particular variety of bacteria and no other Non specific pyogenic infections on the other hand are caused by a large number of different bacteria

The specific infective diseases met with in surgical nursing include Tetanus Gonorrhœa, Syphilis and Surgical Tuberculosis

TETANUS

Tetanus is due to the Bacillus tetani (*Clostridium tetani*), and the characteristic symptoms are due to a toxæmia from the absorption of the specific toxin of the tetanus bacillus

The bacillus of tetanus is a strict anaerobe and forms characteristic spores situated at one end of the bacillus giving it the appearance of a drumstick (Fig 1) It occurs in earth and manure and is a normal inhabitant of the intestines of many herbivorous animals, *e g* horses and sheep

It is most commonly introduced through a wound generally a soiled lacerated or punctured one but in rare instances it may be introduced through a faulty catgut ligature (which is made from sheep s intestines) Tetanus neonatorum occurs from infection of the umbilical cord

The bacilli are localized to the seat of infection, namely the wound and do not invade the blood or lymphatic vessels

The tetanus toxin which is one of the most powerful poisons known passes from the local infective focus by means of the blood stream to the central nervous system where it enters into combination with the nerve cells and acts on them in a manner very similar to strychnine causing muscular rigidity to which after a variable period are added sudden exhausting and intensely painful spasms The tetanus toxin is not absorbed from the intact alimentary tract since it is destroyed by the acid of the gastric juice and by the enzymes of the intestines

There is always a definite period of incubation or latent period between the time of infection with the tetanus bacilli and the development of symptoms This period may be a matter of a few days up to a few weeks but one week is the average time for the first appearance of symptoms The shorter the latent period the more serious is the infection

Signs The patient complains at first of stiffness and cramp like pains about the jaws and neck, and finds he is unable to open his mouth (lockjaw) The spasms then extend to the muscles of the face, trunk and extremities, the eyebrows become raised and the angles of the mouth drawn upwards, giving rise to a fixed grin There is difficulty in swallowing

Violent muscular convulsions ensue whereby all the muscles of the body are thrown into violent contraction and, since the back muscles are the most powerful the body is usually arched backwards, even to the extent of resting on the head and on the heels (opisthotonos) The convulsions are associated with agonizing pain, vice like muscular rigidity, deep cyanosis owing to the cramping of the respiratory muscles perspiration is free and the patient is unable to speak The convulsions are sometimes so violent as to cause rupture of opposing muscles or extravasations of blood They can be brought on by any form of stimulus, such as dressing a wound, a draught, slamming a door, etc and in severe cases unless anæsthetised or deeply sedated, they are brought on by very minor stimuli *e g* moving a hand to take the pulse They may also be brought on by attempts to swallow or talk

The respirations in tetanus are shallow due to rigidity of the muscles of respiration there is loss of the cough reflex, and stridor may occur due to laryngeal spasm

At the same time there are general or constitutional symptoms such as pyrexia constipation and sleeplessness but the intellectual facilities remain clear unless large quantities of sedatives are given

Usually death is due to asphyxia respiratory infection heart failure or general exhaustion

Prognosis The mortality of the disease was formerly estimated to be 90 per cent but this has recently been greatly reduced

Treatment PREVENTIVE MEASURES The first and an important measure is the thorough treatment of wounds Of scarcely less im portance however, is the routine early prophylactic injections of tetanus antitoxin after all wounds An initial subcutaneous dose of 1 500 units is recommended When the wound is suspicious multiple injections are given the subsequent doses being 1 500 units at seven day intervals

A War Office Memorandum (1940) recommends the utilization of chemically treated tetanus toxin or alum toxoid for the purpose of conferring active immunity Two doses of 1 ml each administered subcutaneously with an interval of from six weeks to two months between injections are recommended with a booster dose twelve months later

It is claimed that complete and permanent immunity is produced in the vast majority of persons undergoing such prophylactic inoculation

THERAPEUTIC MEASURES Essential aims in the treatment of tetanus are

Firstly, to control effects already produced by the toxin on the nervous and respiratory systems

Secondly, to neutralize the toxin not yet combined with nerve cells and thus prevent further damage

Thirdly to limit the absorption of toxin from the infected site

Fourthly supportive measures

The dangers of tetanus include

1 Respiratory spasm with cyanosis and asphyxia
2 High temperature (hyperpyrexia)
3 Pneumonia
4 Exhaustion and cardiac failure

While nursing a case of tetanus constant supervision is essential These dangers must be continually borne in mind and all stimulation should be kept to an absolute minimum The patient should be nursed in a quiet dark room with the bed clothes supported on a cradle No visitors should be admitted

Retention of urine is treated by catheterization If it is not relieved a distended bladder will act as a stimulus and cause spasms

The bowels are difficult to regulate and suitable aperients should be introduced into the feeds if necessary, once the spasms are unlikely to recur Sleep is induced by the use of suitable hypnotics Throughout the case great care must be taken to prevent chafing and bedsores and the mouth must have constant attention Tepid sponging is indicated if the temperature rises above 104° Fahr but this may have to be discontinued if it causes spasms Special care of the eyes is necessary lest corneal ulceration be caused Penicillin injections should be commenced prophylactically

In all cases of tetanus efficient and quiet nursing is imperative and each case may require the attention of several capable nurses both day and night

The surgical treatment consists of freely opening up the wound, removing all decomposed blood clot foreign bodies etc, and securing adequate drainage Such an operation should be preceded by an injection of antitoxin

As a therapeutic agent the tetanus antitoxin has not met with great success because much of the toxin is already combined with the nerve cells by the time symptoms appear Treatment with antitoxin should be arranged so as to bring about a saturation of the tissues at the earliest moment

After skin testing tetanus antitoxin is given in a large dose by intravenous injection (200 000 units) or if this is not possible by intramuscular injection The effect of such an injection lasts for seven to ten days and thus a second injection is not required within the first

week A solution of 1/1,000 adrenaline hydrochloride should always be available as injection of tetanus antitoxin may cause a severe anaphylactic reaction

Many drugs have been recommended for controlling the convulsions including bromides, chloral hydrate, morphia paraldehyde and chloroform, but, these only prevent the spasms when given in very large doses which also depress respiration

During many anæsthetics nowadays one of the relaxant drugs is used These have a curare like effect and when given in sufficient dosage they cause complete paralysis of all muscles While this effect lasts the anæsthetist provides artificial respiration by intermittent pressure on a bag containing oxygen and connected to the mask or intratracheal tube

In recent years patients suffering from tetanus have been treated on similar lines not only for minutes or hours but for periods of many days Thus the spasms, and incidentally the pain and anxiety they induce, may be relieved At the same time light anæsthesia is maintained This treatment is continued until the effects of the toxin have worn off Because of the loss of the cough reflex and the inability to bring up sputum a suction apparatus should always be available immediately

For sedation sodium thiopentone (Pentothal) may be given slowly in an intravenous infusion Avertin may be given per rectum or paraldehyde may be given per rectum or by intramuscular injection

Most fatalities in tetanus are due to interference with respiration and to respiratory infections and there is much to be said in favour of an elective tracheostomy that is one performed before a persistent laryngeal spasm makes an urgent tracheostomy imperative

A tracheostomy provides an adequate airway, or rather it will if it is properly looked after and it facilitates the aspiration of mucus from the trachea and bronchial tree If a cuffed tube is used in the tracheostomy opening the administration of a prolonged anæsthetic is easier and safer the aspiration of saliva into the bronchi is prevented and there is no chance of damaging the vocal cords If an intratracheal tube is passed through the larynx and left in place for more than 6 hours damage to the cords may result and this will be followed by laryngeal stenosis Such a catastrophe is avoided by passing the tube through the tracheostomy opening and this should be a routine in any patient who is being given relaxants for days

With a tracheostomy controlled respiration by intermittent positive pressure is of course still essential if a relaxant drug is used Even when such a drug is not used a tracheostomy still provides a much superior airway to that obtained otherwise

The treatment of the patient with prolonged unconsciousness is also discussed in Chapter 14

If the facilities are not available for the prolonged use of relaxants, chlorpromazine (Largactil) with other sedatives is very useful in overcoming the anxiety and in reducing the spasms

If a procedure such as a lumbar puncture is necessary in a patient with tetanus a general anæsthetic is definitely advisable unless the patient is very heavily sedated

Atelectasis may occur in tetanus and its treatment includes broncho scopic drainage physiotherapy, and humidification of the inspired air

The fluid balance is maintained by intravenous infusion at first Later, if there is no regurgitation from the stomach an indwelling Levin s tube passed along the nose and into the stomach is used to give fluids No food should be given by mouth while there is any likelihood of further spasms

The tracheostomy tube is kept in position until bronchial and tracheal aspiration is no longer required and until the respirations are normal

Good nursing is the most important single measure which determines whether or not the patient will recover

GONORRHŒA

Gonorrhœa is an infective disease due to a specific micro organism, the gonococcus (*Neisseria gonorrhœa*) which primarily affects the urethra in males the urethra and uterine cervix in females the vulva in children and the eyes in infants

Although not all nurses have the opportunity of nursing gonorrhœal cases yet they should be familiar with the course of the disease and the precautions necessary to prevent self infection

The gonococcus (Fig 1) is a diplococcus shaped like a coffee bean its flat surfaces being divided by a fine cleft and its convex surfaces lying outwards The cause of gonorrhœa is nearly always coitus with an infected person The gonococcus quickly dies if it is allowed to cool and it is less often conveyed by means of clothes towels, instruments etc which have been contaminated with pus containing the gonococcus

The period of incubation in the majority of cases is between three and five days

Gonorrhœa in the Male

Symptoms The disease is ushered in by a feeling of heat and burning at the orifice of the urethra the lips of which are swollen inflamed and gummy Twenty four hours later the inflammation is well marked and the following symptoms develop scalding pain on micturition, profuse purulent discharge from the urethra and febrile disturbance

This general disturbance consists of general malaise pyrexia loss of appetite etc but in some cases more especially those who have been previously affected with gonorrhœa not only is there sometimes

no general disturbance but also the acute local inflammatory reaction may be absent

At the end of about a fortnight or so the acute symptoms tend to subside and they may do so completely in about six weeks or degenerate into a "gleet" or chronic stage Gleet, or a persistent thin urethral discharge, is due to the infection lingering in some of the many glands and ducts connected with the urethra it may be of indefinite duration and is liable to exacerbations

The infection may spread to involve the prostate, bladder, kidneys vas deferens or testicle, or deeply to involve the tissues surrounding the urethra, thus leading to an abscess or to fibrosis which causes a urethral stricture

In rare instances the gonococcus gains access to the blood and gives rise to arthritis bursitis endocarditis and very rarely gonorrhœal septicæmia Occasionally the eye rectum nose, etc, may be infected by conveyance of infection by means of the patient's hands dressings etc and care must be taken to avoid this

Treatment Until recently the treatment of gonorrhœa in the male (and also in the female) has been a lengthy and uncertain process but this has been completely changed by the introduction of penicillin It is now usually possible to cure the patient in the acute stage by a few injections of penicillin of 50,000 units each In the chronic stage similar injections must be continued three hourly for several days It is essential that sufficiently large injections of penicillin be used otherwise the gonococci become resistant to the drug Treatment with penicillin will of course not cure the complications of gonorrhœa, such as stricture of the urethra

In the acute stage the treatment should also include rest in bed and scrupulous cleanliness The genitals should be bathed with weak antiseptic lotion and the discharge should be collected on pieces of cotton wool which should be burnt immediately they become soiled The diet should be bland and large quantities of bland fluids such as barley water milk and soda, etc should be taken to dilute the urine If necessary, an action of the bowels should be secured by saline purgatives

If the disease becomes chronic and fails to respond to penicillin one of the other antibiotics should be tried The infection will then usually be localized in the posterior urethra, but irrigations with mild astringents such as dilute solutions of potassium permanganate are only very rarely required nowadays

Gonococcal conjunctivitis is discussed in Chapter 34

Gonorrhœa in the Adult Female

In the female the disease begins with a smarting on micturition and slight febrile disturbance, followed in the course of a few days by a

If the facilities are not available for the prolonged use of relaxants chlorpromazine (Largactil) with other sedatives is very useful in overcoming the anxiety and in reducing the spasms

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Gonorrhœa in Children and Infants

Most cases of purulent vulvovaginitis in children are now believed to be of gonococcal origin As a rule the infection is transmitted by infected bed linen, towels, sponges, or even washing in the same water as an infected person

It is a very serious disease and children with a yellow purulent vaginal discharge must be isolated in a special ward

Treatment The treatment does not vary greatly from that employed for gonorrhœa in the adult female Strict attention must be paid to cleanliness and all possibilities of transmitting the disease must be avoided

The vulva is cleansed with a weak antiseptic lotion and covered with a sterile pad which is changed when soiled Penicillin has replaced other methods of treatment Criteria of cure are negative clinical and bacteriological examinations extending over a period of four to six months

Ophthalmia neonatorum and gonorrhœal conjunctivitis in adults is described in Chapter 34

SYPHILIS

Syphilis is a specific infective disease due to the Spirochæta pallida (*Treponema pallidum*) (Fig 1) it is of slow evolution and is propagated by sexual or other contact or by hereditary transmission (Congenital Syphilis) It is an extremely ancient disease Some Egyptian skeletons from 4000 B C have shown lesions suggestive of syphilis

Acquired Syphilis

Syphilitic infection is commonly acquired from the secretions of a chancre or from certain secondary lesions more particularly mucous patches but the blood and certain physiological secretions such as milk urine etc are also infective

In the large majority of cases syphilis is transmitted by sexual intercourse but any object upon which syphilitic organism has been accidentally deposited may serve as the medium of infection such as tableware drinking utensils pipes sponges surgical and dental instruments and objects used in industrial occupations such as glass blowing In these cases a chancre appears at the site of inoculation (extragenital chancre) Infection during surgical and maternity nursing may result in a chancre on the finger

As regards the duration of the infective period there are authenticated records of the transmission of syphilis twenty years or more after infection and the possibility of infection ends only with the death of the last spirochæte

discharge from the vagina, at first mucous but rapidly becoming purulent The urethral infection is seldom severe or lasting In the absence of treatment the acute phase of the disease usually runs a course of about six weeks, but, owing to infection of the uterine cervix it has a great tendency to persist and this is indicated by a slight discharge

The spread of infection is very similar to that which takes place in the male but in addition to the urinary organs it extends to the uterus (endometritis) the Fallopian or uterine tubes (salpingitis) or the pelvic peritoneum

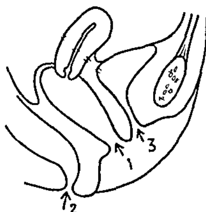


Fig 12 Showing the main routes of entry of gonococci in the female 1 Vulva and vagina 2 Rectum and 3 Urethra

Such infections may become chronic and lead to ill health, interference with the function of the bowel because of adhesions and to sterility because of blocking of the uterine tubes

Treatment With the introduction of penicillin the treatment of gonorrhœa in the female is now on a satisfactory basis In both the acute and the chronic stages the injections and general treatment of rest bland diet, internal use of diluents etc, do not differ from that described for the treatment of gonorrhœa in the male

If the case becomes chronic and does not respond to penicillin and other antibiotics the gonococci will have extended into the cervix and local antiseptic or diathermy treatment to the cervix will then be necessary

In nursing a case of gonorrhœa the nurse must constantly bear in mind the infectious nature of the discharge and the possibility of transmitting the infection *via* her fingers etc to other persons, to the mucous membranes of the same patient or even to herself When attending to dressings or giving treatment in this disease rubber gloves must be worn and the nurse after she has finished must never touch her eyes with her fingers until her hands have been thoroughly cleansed The same precautions should apply in dressing a labial abscess which is sometimes of gonorrhœal origin

The vulva should be bathed with a weak antiseptic lotion and a sterile pad applied This must be burned as soon as it is soiled by discharge, a fresh pad then being applied

All the bed linen from patients suffering from gonorrhœa should be disinfected and separate bed pans and utensils must be kept for such cases

Gummata may form in any part of the body, and when situated near the surface they tend to break down and leave deep ulcers, otherwise they are absorbed leaving deep scars to mark where they have been

Gummata chiefly occur in connexion with *the skin the bones*, and *internal organs* especially the liver brain and testicles

Other lesions occurring in the tertiary stage of syphilis are

Chronic Inflammation of the Arteries which ultimately gives rise to thrombosis or aneurysm

Inflammation of the Nervous System, leading to chronic meningitis, myelitis etc which is denoted by paralysis of various muscles especially those of the eyes or face

Inflammation of the Uterus This is often followed by intra uterine changes leading to abortion or to the death of the fœtus

THE PARASYPHILITIC STAGE produces devitalization of the nerve cells of the brain and spinal cord followed by their degeneration, and gives rise to primary optic atrophy, general paralysis, or locomotor ataxia (tabes dorsalis)

Treatment In nursing any patient suffering from syphilis more especially in the primary and secondary stages the greatest care must be taken to prevent the spread of infection and the nurse must bear in mind the possibility of transmitting infection to other patients, or even to herself

In dressing or attending to such a patient the nurse should always wear rubber gloves especially if any abrasions or cuts are present on her fingers or hands and at the termination of the procedure the gloves should be sterilized and the hands should be well washed with soap and water and then rinsed in 1 in 1 000 perchloride of mercury solution

Separate drinking glasses tableware, toilet articles such as sponges, soap and towels and utensils of all sorts must be distinctively marked All surgical instruments used for such a case should be sterilized by boiling or autoclaving soiled dressings should be burnt at once

All personal or household clothing such as sheets pillow slips, etc must be carefully disinfected by immersion for one hour in 1 in 1 000 perchloride of mercury before being sent to the laundry and woollen materials blankets mattresses etc must be fumigated

Since the chancre itself has a tendency to heal spontaneously rest, cleanliness and an aseptic dressing are usually all the local treatment that is required Moist papules are treated by cleanliness and by keeping the parts dry by placing absorbent material between the affected surfaces

Until recently the drugs used in the treatment of syphilis were mercury bismuth certain organic derivatives of arsenic such as Neoarsphenamine and some iodides but to these penicillin has been added and has completely altered the treatment of syphilis Whereas

After inoculation there is a period of incubation, usually about twenty five days and varying from ten to forty six days

Signs For descriptive purposes four stages are recognized

THE PRIMARY STAGE This has a variable duration from six to twelve weeks and is characterized by a chancre on the penis or labia, etc , and a multiple enlargement of the neighbouring lymphatic glands of the groin, which become hard painless and shotty The chancre or hard chancre is a small round, painless, red elevation with a hard base which may become ulcerated or abraded It usually remains stationary for two or three weeks and then heals leaving a pigmented spot which gradually disappears

SECONDARY STAGE The secondary manifestations do not as a rule show themselves earlier than six weeks from the formation of the chancre and usually persist for about two years The chief characteristics of this stage are as follows —

1 *Skin Eruptions* which are usually non irritating painless and copper coloured but they may appear in various guises

2 *Sore Throat* which is characterized by small ulcers on the back of the pharynx or as a deep excavated ulcer on the tonsil

3 *Pyrexia* which is associated with headache, anæmia, and other signs of constitutional disturbance but it has no well defined characteristics

4 *Moist Papules* at the creases and moist areas of the body, such as the perineum axillæ and between the toes, or in the form of mucous tubercles or *Condylomata* at the junctures of skin and mucous membrances for example at the anus or the angles of the mouth Condylomata are flat outgrowths with well defined margins and covered with a dirty grey secretion which is extremely infective

5 *Periostitis* causing pain in the bones worse at night and increased on pressure

6 *General Enlargement of the Lymphatic Glands* of the body especially those of the neck

7 *Temporary Thinning of the Hair* which may be generalized but more usually it is localized and gives rise to irregularly distributed round bald areas

8 *Iritis* or inflammation of the iris commonly affecting one eye before the other and usually coming on about three to six months after infection

TERTIARY STAGE At the termination of the secondary stage tertiary symptoms may show themselves at once or after a period of quiescence This tertiary stage is characterized by chronic inflammatory changes associated with the formation of new fibrous tissue The latter may be generalized but usually it is more localized and takes the form of a definite mass (gumma) which undergoes necrosis and forms a tough, yellow slough

Growth is slow and development tardy, and such babies remain long in a state of infancy The infant is constitutionally debilitated and frequently succumbs to minor ailments, often without apparent cause

EARLY CONGENITAL SYPHILIS This is a type commonly met with in practice, the signs usually developing in the first weeks of life The following are its chief manifestations —

Snuffling due to syphilis rhinitis

Erythematous Rash on the scrotum, thighs and buttocks growing into condylomata at the anus

Fissures about the Lips (rhagades), especially at the angles of the mouth The secretions from these fissures are very infectious and were the common cause of chancre on the nipple in wet nurses

Hair The syphilitic infant usually has long fine, straight dark hair

LATE CONGENITAL SYPHILIS At the period of the second dentition or at puberty the disease tends to reappear in tertiary form

In addition to the usual tertiary phenomena the patient may exhibit a *syphilitic facies peglike teeth* and " Hutchinson s tetrad of symptoms namely *blindness, deafness lameness* and *impotence*

The nose is depressed at the bridge, but uptilted at the point the forehead is prominent and broad, and striate scars runs from the corners of the mouth

Inflammation of the Cornea (*Interstitial Keratitis*) may occur The cornea is hazy with blood vessels showing through the haze and appear ing as pinkish salmon patches It generally affects both eyes though one is usually attacked before the other and it lasts for months Interstitial keratitis may lead to permanent opacity of the cornea and impaired vision or even blindness

Treatment All the methods which have already been described for preventing the spread of infection in the acquired form should be rigidly applied to both mother and child The child should be nursed by the mother alone or be artificially fed under no circumstances should a wet nurse be employed

The infant is rapidly brought under the influence of penicillin by giving it 250 000 units per pound of body weight This is given in divided doses every three hours over a period of seven days or more To avoid reactions the injections should not exceed 2 000 units for the first two days

In both the adult and the child with tertiary syphilis the course of penicillin should be followed by a course of bismuth injections

TUBERCULOSIS

TUBERCULOSIS is a specific infective disease due to the tubercle bacillus (Mycobacterium tuberculosis of Koch) a relatively long and thin non sporing bacillus Its length is about half the diameter of a

long courses of treatment were previously employed, more effective results are now obtained in a few weeks

PENICILLIN TREATMENT Penicillin alone is sufficient treatment for early syphilis, whether in infancy, during pregnancy, or at other times in the adult In the later tertiary stages only is it necessary to include other methods of treatment

A large dose of penicillin is often given at first, for example, 2,000 000 to 3 000 000 units, and in very early cases this single dose is all that is required In other cases more prolonged treatment is necessary After the first dose of penicillin, however a Jarisch Herxheimer reaction is likely and is due to inflammatory swelling around the mouths of the coronary arteries in the cerebral blood vessels and in the mucosa of the larynx This reaction may be lessened by the administration of cortisone with the penicillin

Because of the possibility of such a reaction only small doses of penicillin are sometimes given at first

When more than a single dose is required crystalline penicillin is usually given as 100 000 units every three hours or if Procaine penicillin G in oil is used, an injection such as 1 000,000 to 1,500 000 units is given on alternate days

BISMUTH PREPARATIONS are given by the intramuscular route, but they may produce toxic reactions Special care of the mouth is necessary for bismuth may cause a blue or black line around any septic teeth, and this may be followed by a severe stomatitis The urine should be repeatedly examined for the presence of albumin

The Wassermann reaction is taken before and at intervals after the penicillin or other therapy

Congenital Syphilis

Congenital syphilis is due to the intra uterine infection of a fœtus with Spirochæta pallida

It is an even more serious disease than the acquired form, causing deformities hindered development and often proving fatal With the exception of the primary chancre every feature of the acquired form may be seen in this disease

SIGNS The signs differ according to the period at which the disease becomes manifest

AT BIRTH The newly born syphilitic infant may be healthy or may present well marked evidence of the disease In the latter case it is a small wizened creature with scanty eyebrows and hair and having a prematurely aged face The skin is dry lax and flabby the com plexion *cafe au lait* colour and the child emits a peculiar hoarse cry Occasionally the child is still born

A skin eruption is often present commonly in the form of pustules about the hands and feet

Growth is slow and development tardy, and such babies remain long in a state of infancy The infant is constitutionally debilitated and frequently succumbs to minor ailments, often without apparent cause

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TUBERCULOSIS

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red blood cell The tubercle bacillus belongs to the group of "acid fast bacilli which are so called because of their ability, when once stained, to resist decolorization by acids The bacilli possess much the same degree of susceptibility to heat as other non sporing bacteria, but they have a much higher degree of resistance to disinfectants

Tubercle bacilli may be found in the sputum and other discharges from tuberculous patients in the dust of rooms occupied by such patients in the milk of cows with tuberculous udders, or, in fact in whatever is contaminated with tuberculous discharges The tubercle bacillus does not multiply outside the body

Cause of Infection As with other infective diseases the cause of the infection may be considered as (i) the presence of the tubercle bacillus and (ii) the opportunity for infection

The condition of the body that favours infection consists in a lowering of the resistance of the body to infection and this may be either inherited or acquired

Pathology

METHODS AND CHANNELS OF INFECTION The paths of entrance of the turbercle bacillus into the body are three in number —

By Inoculation Rarely this occurs because injuries or abrasions have become infected by tubercle bacilli and is seen chiefly in pathologists post mortem attendants butchers etc A nurse may be the victim when she cuts herself with the sputum mug of a phthisical patient

By Inhalation This is the common means of infection the bacilli usually lodge on the tonsils or on the mucous membrane of the bronchial tubes and the result in each case may be a localized infection or spread to the lymph glands

By Ingestion Here the infection occurs *via* the alimentary canal, and occurs in children (owing to their drinking tuberculous milk) or in phthisical patients (owing to swallowing their tuberculous sputum) Tuberculosis of the œsophagus or stomach is extremely rare, but it is less uncommon especially in children in the intestine, where it presents in two forms —

(i) *Primary* The tubercle bacilli may lodge on some of the lymphoid tissue of the intestine (*e g* Peyer s patch or solitary follicles) and there multiply and produce tuberculous ulceration of the intestine

(ii) *Secondary Spread* This may occur —

By direct extension to involve the intestine lower down

By regional infection to produce tuberculosis of the mesenteric glands (tabes mesenterica) or tuberculous peritonitis

Whether or not a primary lesion occurs at the site of entry of the tubercle bacillus appears to depend on the dose of the bacilli, for with

a large dose a local lesion invariably follows, but with a small dose no local lesion may be observed

In babies tuberculosis is usually widespread and rapidly fatal. In older children caseating glandular tuberculosis and tuberculosis of bones joints and internal organs occurs. In the adult tuberculosis is usually limited to the lungs

Generalized tuberculosis (acute miliary tuberculosis) results from an acute and generalized dissemination from a chronic local lesion

SPREAD OF TUBERCULOSIS After tubercle bacilli have entered the body the disease is spread by various means —

1 *By Direct Spread* through the tissues or along certain open tubes, *e g* the bronchi ureters, etc

2 *By Lymphatic (or Regional) Spread* The bacilli are conveyed by means of the lymphatics to the nearest lymphatic glands, *e g* from the tonsil to the lymph glands of the neck

3 *By General Blood Spread (Hæmatogenous Spread)* A tuberculous lesion ulcerates and discharges into the blood stream. Emboli containing tubercle are then conveyed to other parts of the body and give rise to tuberculous lesions. This is the mode of origin of remote foci of tuberculosis *i e* of bones joints, kidneys testicles, etc, which are embolic in origin

TISSUE CHANGES The tubercle bacillus having effected an entry, a struggle between it and the cells of the tissues ensues. If the bacilli make good their foothold they multiply and spread into the adjacent parts creating a TUBERCLE. A tubercle is the reaction of the tissues to tubercle bacilli and consists of a hard round, semi transparent grey cellular mass about the size of a millet seed and this is surrounded by a zone of inflammation

As the process extends the tubercles spread into the adjacent tissues and destroy them but coincident with this progressive inflammation a fatty degeneration of the original nodules occurs forming cheese like material (caseation)

This tuberculous inflammatory reaction converts the tissues into a soft pulpy mass studded with grey or yellow tubercles and designated tuberculous granulation tissue

Suppuration In most cases in which caseation has occurred the process continues to spread until the caseous mass reaches a definite size when an exudation of serum takes place into it and a chronic abscess is formed. The pus of such an abscess consists of disintegrated fatty material mixed with a variable amount of serum

This abscess differs markedly from an acute abscess and furthermore is unaccompanied by the usual signs of inflammation hence it is designated a cold or chronic abscess

Fibrosis The granulation tissue surrounding the caseous mass is converted into fibrous tissue which contracts and shuts in the infective

process and this constitutes Nature's method of cure The liquid part is absorbed, and the caseous material gradually dries up and may become calcified

Secondary Pyogenic Infection A tuberculous lesion, especially if it is ulcerated and communicates with the external air or alimentary canal may be infected with pyogenic organisms

Diagnosis The diagnosis is confirmed by the finding of tubercle bacilli in sputum, pus, urine or other fluid from the suspected patient but this may be difficult and sometimes a positive result is not obtained till after several examinations

In some cases of pulmonary tuberculosis in whom the sputum is repeatedly negative it is possible to find the organisms by the method of gastric lavage, that is, the washing out of the stomach

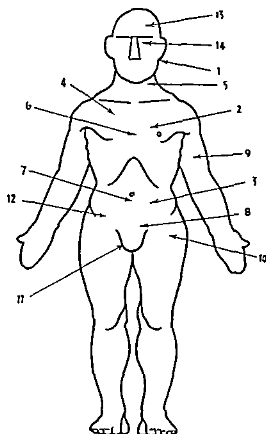


FIG 13 Diagram showing the sites of infection in tuberculosis

The sites of primary infection —1 Tonsillitis 2 Bronchitis and 3 Enteritis The sites of direct and regional extension — 4 Lungs 5 Cervical lymph glands 6 Mediastinal lymph glands 7 Mesenteric lymph glands 8 Peritoneum 9 Bones 10 Joints 11 Testicles epididymes seminal vesicles bladder and kidneys 12 Ileocæcal junction of the bowel 13 Brain and meninges and 14 Choroid of the eye

with a small amount of sterile saline and then the examination of the material obtained Such a lavage must be performed with the patient fasting and without even smelling food, otherwise dilution of the gastric contents occurs Thus, gastric lavage is best performed first thing in the morning while fasting and just after waking This method is especially of value in young infants who usually swallow their sputum

Bronchial lavage' is another method of obtaining bacilli for examination and is of use in cases in which gastric lavage is repeatedly negative Bronchial lavage" is performed by anæsthetizing the back of the pharynx with amethocaine hydrochloride, then 2-4 ml of sterile saline are dropped through the vocal cords The mucus which is produced is coughed up into a Petri dish, and is then examined and cultured

The tubercle bacillus will not grow within 24 hours on ordinary laboratory media like most pathogenic organisms instead it requires a special medium such as Lowenstein s or Petrognani s and even then it is several weeks before any growth is obvious

Because of this difficulty with its cultivation suspected material is sometimes injected into a guinea pig In positive cases the guinea pig will usually show evidence of tuberculosis after a month or so

Treatment

PREVENTIVE TREATMENT Everything that has been contaminated by discharges from infected patients and animals must be disinfected or destroyed The sputum of patients suffering from pulmonary tuberculosis the pus from tuberculous abscesses the urine of patients suffering from tuberculosis of the bladder kidney, etc are all sources of infection and must be disinfected

Dairy milk may be contaminated with tubercle bacilli but, these are killed by heating the milk to a temperature of 72° Cent (162° Fahr) for 15 minutes (Pasteurization)

A less virulent form of the tubercle bacillus (the bacillus of Calmette and Guerin—B C G) is used occasionally for immunizing against tuberculosis

CURATIVE TREATMENT Tuberculosis possesses a natural tendency towards recovery, provided that proper general and local treatment is carried out

(i) *General or Constitutional* treatment

Fresh Air The bed should be on a balcony and the patient should live out of doors both by day and night, but great care must be taken to wrap him up well lest he catches a chill

Food The patient should have plenty of good attractive food especially meat and the usual routine includes three pints of milk and two eggs daily in addition to their ordinary diet

Drugs The drugs recommended in tuberculosis in the past were cod liver oil iodine iron and arsenic, but streptomycin, dihydro streptomycin, isoniazid and para aminosalicylic acid have replaced all the others A typical course of treatment is to start the patient on isoniazid (INH) (100 mg twelve hourly by mouth) para aminosalicylic acid (PAS) (3 or 4 grammes six hourly by mouth) and streptomycin (½ to 1 gramme daily by intramuscular injection) After six or more weeks when the sensitivity of the organism has been determined it is usual to stop one of these three drugs The need for more than one drug is explained by the development of resistant strains of the organism when only one is used

However these drugs are all somewhat toxic and are liable to produce fever and a rash In addition isoniazid may cause mental upsets and a peripheral neuritis, streptomycin may cause giddiness, and para aminosalicylic acid may cause nausea, loss of appetite and abdominal discomfort

The use of these drugs represents a great advance in the treatment of tuberculosis and one indication of this is the sudden decline in the use of artificial pneumothorax (AP) and of artificial pneumoperitoneum in order to rest the lung

(ii) *Local Treatment* The general principles of local treatment are similar to those used in other chronic inflammations

Rest Both physical and physiological rest of the diseased part should be maintained for example a tuberculous knee should be splinted and not used to bear weight while the disease is active

Operative Treatment The ideal treatment for a localized tuber culous lesion is its complete excision This, however, is not always possible and it is not indicated when the patient is responding to anti bacterial treatment with drugs

ANTHRAX

Anthrax is due to the accidental infection either through the skin or *intestines by a specific bacillus the bacillus anthracis the producer* of splenic fever in sheep and cattle When it occurs in man it is usually the result of contact with the bodies or hides of infected animals and it is particularly prone to occur in tanners and butchers Occasionally it has been due to the use of contaminated shaving brushes

Symptoms Two chief forms of the disease have been described —

EXTERNAL ANTHRAX or Malignant Pustule characterized by an angry red pimple soon developing into a black slough surrounded by vesicles and a large area of redness and attended with symptoms of toxæmia and later by septicæmia (anthracæmia)

INTERNAL ANTHRAX which usually results from eating the flesh or drinking the milk of infected animals and is characterized by an acute

enteritis, usually terminating in anthracæmia When anthrax attacks the respiratory tract it is known as woolsorter s disease, and an acute pleuropneumonia develops

Treatment EXTERNAL ANTHRAX The patient should be confined to bed as there is always the risk of a septicæmia The indurated area should be immobilized by splints or sandbags and the lesion dressed with eusol or 2 per cent formalin

The discharge from the pustule is extremely contagious Attendants and nurses must therefore wear rubber gloves which are sterilized each time they are used, and all dressings must be burnt immediately

INTERNAL ANTHRAX The gastric and intestinal contents and the sputum all contain the anthrax bacilli and, unless great care is taken to prevent contamination any of these will transmit the disease to others

Formerly treatment of both external and internal anthrax was with antianthrax serum (Sclavo s) and neoarsphenamine, but these have been almost completely replaced by penicillin, chloramphenicol and various sulphonamides

CHAPTER 6

WOUNDS AND SKIN GRAFTING

Definition and Varieties

A WOUND is defined as an injury to the body involving the division of the skin or mucous membrane and deep enough to cause bleeding If there be no division of the skin or mucous membrane but the tissues are injured there is a *contusion* or *bruise* Wounds are divided into the following varieties —

Incised Wounds, produced by sharp cutting instruments The edges of the wound are clean cut and gape, bleeding is free as a rule, and healing occurs readily if the wound remains aseptic

Lacerated Wounds, caused by dragging or tearing when for instance, the arm is torn by a nail The wound has irregular ragged edges, which are liable to necrosis owing to interference with their blood supply

Contused Wounds, produced by blunt instruments, *e g* a policeman s baton There is great bruising of the edges and healing does not readily occur They differ from lacerated wounds in that the bruising predominates over the tearing

Punctured Wounds, made with pointed instruments such as a dagger, bullets etc They are deep and narrow, and are dangerous owing to their liability (i) to injure important organs and (ii) to their tendency towards suppuration because of their depth and imperfect drainage Furthermore the whole or part of the penetrating instrument is some times left in the wound as a foreign body

DANGERS OF WOUNDS The immediate danger is that of hæmorrhage or loss of blood The remote danger of sepsis or infection of the wound with pus producing organisms has been discussed in Chapter 3

Healing of Wounds

Wounds heal in two ways by *First Intention* and by *Secondary Intention* or *Granulation*

In healing by first intention three stages can be recognized—the arrest of hæmorrhage, the adhesion of the margins of the wound by lymph and the formation of a scar Hæmorrhage is arrested by the contraction and retraction of the cut ends of the divided blood vessels and by the clotting of the blood As a result of the trauma inflammation occurs This causes the exudation of inflammatory lymph which sticks the sides of the wound together and the walls now show masses

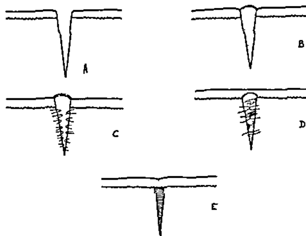


FIG 14 Diagrams showing the stages during healing of a simple incised wound

A The wound *B* The space between the wound edges fills with lymph and cells *C* Capillary loops grow into this cellular exudate *D* The capillary loops join together wavy strands of fibrous tissue are laid down and the cut edges of the wound at the surface are united by epithelium *E* The inflammatory exudate and the capillar es are completely replaced by fibrous tissue which lays down fibres of collagen This contracts and thus the scar becomes appreciably smaller

of small round cells which are produced by the inflammation The round cells invade the inflammatory lymph and then turn into spindle cells which produce young fibrous tissue This firmly unites the cut surfaces, but contracts later and leaves only a thin white scar Simple or incised wounds should heal by first intention but to obtain this result the edges should be closely approximated, the retention of blood slight and the wound should remain aseptic

When the attempt at primary union fails healing occurs by granulation or secondary intention Granulation tissue is produced and consists of a mass of round cells and small capillary blood vessels It resembles the tissue which displaces the inflammatory lymph in the case of healing by primary union *In a similar manner to that described* for a healing ulcer, granulation tissue grows up from the bottom of the wound until it rises to the level of the skin and then the superficial layers of the skin grow over the granulation tissue and finally a scar forms This contracts and draws the wound surfaces together If the contraction is excessive deformity may be produced as is often the case with scars from infected burns

A constant discharge takes place from the granulation tissue until the skin has completely grown over it If the wound be aseptic the discharge is inflammatory lymph but if the wound is infected it may be purulent A scab consists of a mixture of dried blood and inflammatory lymph it plays no part in the repair of a wound but is Nature s method of forming a dressing

To sum up wound healing may be regarded as an orderly process which is affected by local and systemic factors

The local factors determining the reparative processes are the amount of damaged tissue in the wound, the blood supply to the damaged tissues the nature of the exudate in the wound and adjacent tissues, and the number and character of the infecting organisms

The systemic factors include the age of the tissue (whether adolescent, adult or senescent), the state of hydration, the state of nutrition (especially in relation to protein and to loss of weight), the vitamin balance and the state of the general circulation and of the blood

Vitamin C is known to play an important part in the formation of fibrous tissue in wounds, and vitamin K in the production of pro thrombin and so in the control of hæmorrhage

Treatment

The treatment of accidental wounds varies in accordance with the nature of the injury As before stated incised wounds tend to heal aseptically by primary union whilst lacerated and punctured wounds tend to suppurate, and the treatment of these accidental wounds must vary according to whether the wound is clean or contaminated with bacteria

NON INFECTED ACCIDENTAL WOUNDS The treatment of non infected accidental wounds necessitates attention to the following points

(a) *Arrest of Hæmorrhage*
(b) *Cleaning of the Wound*
(c) *Coaptation of the Margins*
(d) *Rest of the Affected Part*

It is most important to arrest hæmorrhage for not only does continued bleeding prevent accurate coaptation of the margins of a wound and thus check primary union but the blood presents a suitable nidus for the development of bacteria The methods of stopping bleeding which will be discussed in Chapter 16 are —

1 Ligation of the open blood vessel
2 Ligation of the artery on the heart side of the wound
3 Suturing the wound so as to include the bleeding vessel in the suture
4 Torsion or twisting the mouth of the blood vessels is of value for comparatively small vessels as it does away with the necessity for a ligature
5 Application of hæmostatic agents

Having arrested the hæmorrhage we next proceed to the cleansing of the wound it should be covered with a clean dressing while the surrounding skin is thoroughly cleansed and this is done in a similar manner to that described under Surgical Technique The skin is

shaved scrubbed with soap and water fat removed by alcohol, ether, etc , and finally the skin is treated with iodine or similar skin antiseptic The wound is then uncovered and washed free from foreign particles by sterile Normal saline or 1/1 000 aqueous solution of flavine, and finally mopped out with saline or antiseptic solution After this the wound must be examined carefully to determine its depth, to see if any foreign bodies are embedded in it, and to discover whether there is injury to important structures, such as nerves tendons joints etc

The next step is to ensure that the wounded surfaces are accurately applied to one another coaptation of wound surfaces and margins is maintained by sutures metal clips (Michel s) adhesive strapping, or a gauze and collodion dressing

The wound is dressed and, since rest is essential for rapid healing, the part is splinted and bandaged in the most favourable position for repair

SOILED OR CONTAMINATED WOUNDS In a soiled or contaminated wound the tissues have been laid open by some infecting agent they have been in part devitalized by that agent, and they have had implanted on them a bacterial infection Also there will be an exudate from the wound surface consisting primarily of blood and blood serum

Gunshot wounds differ from other soiled or contaminated wounds in that a heavy dose of infective bacteria is carried into the tissues along the path of the missile

The treatment of soiled or contaminated wounds necessitates attention to the following points —

1 *Mechanical Cleansing of the Wound and Hæmostasis*
2 *Chemical Treatment of the Wound*
3 *Closure of the Wound*
4 *Rest of the Affected Part*

Irrigation and Debridement Most important in the preparation of such a wound are the mechanical cleansing and a systematic resection of all bruised skin aponeurosis muscle etc that is likely to be devitalized The skin should be shaved washed with soap and water and painted with iodine in the usual manner The wound is then laid open excising all devitalized tissues (debridement) removing all dirt foreign particles blood clot etc and securing hæmostasis The mechanical cleansing of the wound is greatly aided by its irrigation with sterile Normal saline or with a non irritating antiseptic fluid

Chemical Treatment of the Wound ANTISEPTICS If, while the wound is being cleansed it is irrigated with an antiseptic such as 1/1 000 flavine or monacrin some of the bacteria will be killed However, if all the foreign material and devitalized tissues have been removed and if care is taken to prevent further infection of the wound

To sum up, wound healing may be regarded as an orderly process which is affected by local and systemic factors

The local factors determining the reparative processes are the amount of damaged tissue in the wound, the blood supply to the damaged tissues, the nature of the exudate in the wound and adjacent tissues and the number and character of the infecting organisms

The systemic factors include the age of the tissue (whether adolescent adult or senescent) the state of hydration the state of nutrition (especially in relation to protein and to loss of weight) the vitamin balance and the state of the general circulation and of the blood

Vitamin C is known to play an important part in the formation of fibrous tissue in wounds and vitamin K in the production of pro thrombin and so in the control of hæmorrhage

Treatment

The treatment of accidental wounds varies in accordance with the nature of the injury As before stated incised wounds tend to heal aseptically by primary union, whilst lacerated and punctured wounds tend to suppurate and the treatment of these accidental wounds must vary according to whether the wound is clean or contaminated with bacteria

NON INFECTED ACCIDENTAL WOUNDS The treatment of non infected accidental wounds necessitates attention to the following points

(a) *Arrest of Hæmorrhage*
(b) *Cleaning of the Wound*
(c) *Coaptation of the Margins*
(d) *Rest of the Affected Part*

It is most important to arrest hæmorrhage for not only does continued bleeding prevent accurate coaptation of the margins of a wound and thus check primary union but the blood presents a suitable nidus for the development of bacteria The methods of stopping bleeding, which will be discussed in Chapter 16 are —

1 Ligation of the open blood vessel
2 Ligation of the artery on the heart side of the wound
3 Suturing the wound so as to include the bleeding vessel in the suture
4 Torsion or twisting the mouth of the blood vessels is of value for comparatively small vessels as it does away with the necessity for a ligature
5 Application of hæmostatic agents

Having arrested the hæmorrhage we next proceed to the cleansing of the wound it should be covered with a clean dressing while the surrounding skin is thoroughly cleansed and this is done in a similar manner to that described under Surgical Technique The skin is

Rest of the Affected Part Immobilization of the injured parts is essential for thereby not only is the comfort of the patient increased but the spread of infection is inhibited

All patients with soiled or contaminated wounds should have pro phylactic doses of antiserum tetanus (at least 1,500 units), tetanus toxoid (1 ml) and polyvalent gas gangrene antiserum (10 000 units)

Infected Wounds When infection is established the bacteria have not only had time to multiply on the wound surface but have grown out into the contiguous tissues hence the characteristc phenomena of local wound infection are present together with a greater or lesser degree of fever The patient complains of pain and discomfort in the wound on examination, the wound may show no attempt at repair the edges are swollen and the surrounding skin is red and œdematous The patient complains of general malaise, his temperature is raised the pulse and respiration rapid the tongue furred the appetite lost and the bowels sluggish

The walls of infected wounds contain innumerable organisms which could not be removed by one of the older antiseptics These chemicals cannot penetrate far enough into the tissues to get at the bacteria at the site where they are multiplying, secondly, most antiseptics are rapidly rendered inert by blood serum and pus, and lastly, they only make matters worse by damaging the tissue cells and destroying the natural defences of the body *i e* paralysing the leucocytes and destroying the bactericidal elements of the blood

The treatment of infected wounds moreover varies in accordance with the virulence of the infection and with the resistance of the natural tissue defences of the body

DEEPLY INFECTED ACCIDENTAL WOUNDS This type may be exem plified by that of a neglected street accident and the infection may vary in intensity from a severe suppurating contused wound to hospital gangrene

One method of treatment of this variety of septic wound that of Carrel and Dakin aims at frequent periodic flushing of the whole infected surface with a practically non irritating fluid hypochlorite of soda, which possesses a moderate degree of bactericidal power and also helps to dissolve any dead tissue present The irrigation is carried out through several rubber tubes placed in the wound and incorporated in the dressings

If such deeply infected wounds are opened up to allow drainage, they may usually be successfully treated with eusol packs In other cases the use of penicillin, etc clears up the infection Thus, the Carrel Dakin method is rarely used now

The patient s general health should be maintained by allowing him an abundance of fresh air and sunshine and feeding him on a nutritious diet

it may be expected that in most cases the remaining organisms will be overcome by the defences of the body

Formerly it was sometimes the practice to smear BIPP (bismuth, iodoform and paraffin) over the surfaces of the wound after they had been cleaned and then to close the wound with the hope that the BIPP would exert a continuous antiseptic action without the need for frequent dressings Although this method was sometimes successful it was occasionally followed by bismuth poisoning Nowadays if anything is implanted or dusted into the wound penicillin, streptomycin and some of the sulphonamides are preferred They are more effective than BIPP and there is less risk of toxicity

After the initial irrigation and dressing no further treatment of the wound is undertaken for a few days when the wound is dressed and then if the wound is not already sutured delayed primary suture may be undertaken

PENICILLIN With the object of checking the implanted infection in soiled or contaminated wounds penicillin may be applied after debridement as a powder diluted with sulphanilamide (1 in 100 to 1 in 10) and containing 5 000 units of penicillin per gramme

It is now the custom for patients with contaminated wounds to receive penicillin injections and other antibiotics till the risk of infection has passed

Closure of the Wound Where possible accurate coaptation of the wound surfaces and margins should be secured by sutures but, where dead spaces cannot be obliterated they should be drained As a rule, soft drains should be used instead of rigid ones The ordinary rubber drainage tube if carelessly used may cause devitalization of adjacent tissues from pressure secondary hæmorrhage by erosion of blood vessels or paralysis of nerves All that is necessary in many cases is to insert something into the tissues such as a piece of soft folded rubber or a few strands of silkworm gut which will keep a passage open

In the past drains have been left in position too long with the result that the drainage track has become secondarily infected from the skin As a result of this the track became rigid and a sinus exuding pus was produced this not only demanded treatment but unnecessarily prolonged convalescence

Ribbon gauze is sometimes employed as a drain but it must be remembered that it will not drain any wound for more than a few hours its meshes soon become clogged with lymph, and then it acts as a plug instead of a drain If gauze is used care must be taken to see that the wound is very lightly packed and the gauze frequently renewed Ribbon gauze tends to become rolled up like string and it may become lost in the depths of the wound For these reasons gauze squares are to be preferred especially for wounds about the anus

care there is no danger of adding infective material to the wound The surface of the wound should be washed with 1/1,000 flavine and a solution of iodine or similar antiseptic is applied to the surrounding skin

The strip of the damaged skin is then excised from the margins and the wound enlarged

In wounds caused by high explosives the extent of the damage in deeper tissues particularly in the muscles is generally very much more extensive than that in the skin or superficial layers Hence excision of the deep fascia and damaged muscles must be free and the operation proceeds layer by layer into the deeper tissues until the bottom of the wound is reached

Efficient treatment includes the removal of foreign material and of all tissues which have been devitalized

The wound is then dusted with penicillin and sulphanilamide powder and covered with ' Vaseline ' gauze

The final stage is the application of a well moulded plaster of Paris cast applied direct to the skin except over bony prominences, so as to effectively immobilize the injured part

War wounds first seen after twenty four hours are infected If not actually suppurating natural defensive barriers are being erected and they should be treated by less radical methods

If more than forty eight hours have elapsed before the case is first treated the Winnett Orr principle of incision, drainage and rest is usually sufficient for if no gas gangrene has developed in an untreated wound within that time it is not likely that it will do so

Sutures

Sutures may be —*Interrupted* where each stitch is tied off separately, and *Continuous* when the thread is carried unbroken from end to end of the wound

Interrupted sutures include the simple interrupted, which consists of a simple loop Halsted s mattress suture the vertical mattress suture and the double tension suture

The commoner varieties of continuous sutures are the simple con tinuous, which is really a method of oversewing the blanket stitch where each stitch forms a half hitch with the one before, the continuous mattress suture and the intracuticular stitch This latter continuous suture is inserted between the skin edges and does not cause stitch marks

Dressing a Wound

Blanket dust is one of the main sources of airborne streptococci in hospital wards and it plays an important part in cross infection The simple act of making a bed may throw into the air as many as 2 500 micro organisms per cubic foot The treament of ward floors

In foul and sloughing wounds a liberal surface application of pure urea may yield excellent results

GRANULATING WOUNDS This is a variety of infected wound in which the natural tissue defence of the body has been marshalled against the invading host of bacteria

The wonderful supply of blood vessels in granulation tissue ensures a supply of leucocytes and serum to the surface of the wound where the combat with the bacteria is being waged

Efficient drainage must be established

As long as an abscess remains unopened the natural tissue defences are impeded by the disturbing influence of tension caused by the rapidly accumulating pus

Heat is applied locally, in the form of boric fomentations, by warm antiseptic baths or by lamps

Good food and fresh air are most important

In the case of an operation wound which has become infected a sufficient number of stitches should be removed to allow free drainage Wounds that are effectively drained and free from all foreign particles universally tend to recover but on the other hand if drainage is not adequate a degree of tension is soon established which may even endanger the life of the patient because of the development of a septicæmia

Heat may be applied every three hours until the infection subsides

As soon as possible the infecting organisms are identified, and after their sensitivities are established the appropriate antibiotics are given and are perhaps also applied locally

If the granulations become excessive a piece of silver nitrate held in a swab or forceps may be applied to the surface to burn them down

War Wounds As stated previously war wounds differ from soiled or contaminated wounds in that a heavy dose of infective bacteria is frequently carried in at such great velocity that the microbes are thrust into the tissues along the path of the missile The Trueta technique which is a reliable method wherewith to obviate the risk of gas gangrene or fulminating sepsis is based upon five principles (1) urgency in surgical treatment (2) cleansing of the wound (3) excision and incision of the wound (4) provision of drainage, and (5) immobilization in a plaster of Paris cast

As the risk of serious infection is directly proportional to the time interval between the receipt of the injury and the institution of surgical treatment the successful healing of war wounds depends largely on the promptitude with which the operation is undertaken The optimum time for such treatment is usually accepted as being up to six hours

The wound is covered with sterile gauze and the surrounding skin is cleansed with soap and water in a like manner to that adopted for the preparation of the operating surgeon s hands If this is done with

dressing should be done for at least an hour after bed making, ward sweeping and dusting have been completed

Masks should be worn by all dressers and observers, and all patients should be silent

The nose and throat of the patient to be dressed is a possible source of infection to his own wound and he should be instructed to turn and keep his head well to one side or be given a mask

The following instruments should be sterilized —Dissecting forceps dressing forceps, probe and scissors and they should be placed in a dry sterilized bowl A drum containing sterilized towels and dressings should also be ready

In order to carry out the dressing satisfactorily two nurses are required The second prepares the patient exposes the site of the dressing and removes the bandage and the outer layer of wool The first nurse having made her hands surgically clean, arranges sterile towels round the wound to isolate it, and then removes the remainder of the dressings with dressing forceps Dirty dressings should be placed in separate covered bins with foot operated lids and not in any container on the trolley or dressing tray The dressing should be carried out with the aid of instruments instead of using the fingers and in all septic cases gloves must be worn A fresh dressing is then applied sterile gauze is generally placed next to the wound and is covered by cotton wool The dressing must be light absorbent and aseptic and is fixed in place by a bandage with even light pressure over the whole wound

Unless the patient is debilitated or is suffering from cancer stitches are removed from aseptic wounds about the sixth to eighth day but in the case of face and neck wounds it is advisable to take them out after forty eight to seventy two hours owing to their tendency to leave disfiguring marks To remove stitches fine sharp pointed scissors which cut well at the points are the most convenient The knot is seized with dissecting forceps and the stitch pulled gently to one side until a part that has been buried in the skin is seen (Fig 15) This part, which may be regarded as aseptic is then cut through and the stitch is pulled out from the opposite side with dissecting forceps Care must be taken to avoid making the edges of the wound gape

When a non absorbable intradermic suture has been used the suture is cut close to one end of the wound A fair sized round swab is then wrung out of lotion and pressed firmly on the wound Then with a good grip of the other end of the stitch it is pulled firmly without jerking The swab keeps the wound straight and prevents it from wrinkling up and gripping the thread

If drainage tubes are used in a wound they are usually removed after twenty four to forty eight hours The tube is released by cutting the holding stitch

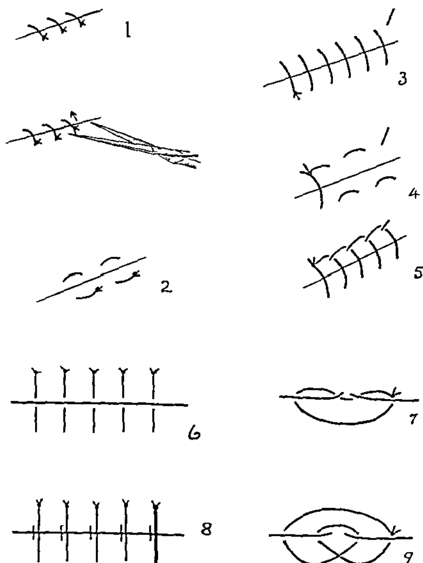


FIG 15 Types of sutures

1 Interrupted right angled sutures To remove one of these sutures it is swabbed with an antiseptic then rotated and cut in a part which was previously buried in the tissues 2 Interrupted mattress sutures 3 Continuous over and over suture 4 Continuous mattress suture 5 Blanket suture 6 Interrupted vertical mattress sutures 7 Cross section of a vertical mattress suture 8 Interrupted double tension sutures 9 Cross section of an interrupted double tension suture

with a dust laying oil (spindle oil) reduces the possibility that micro organisms on them will be distributed into the air

Ward dressings must be carried out with full aseptic precautions and just as much care bestowed on them as on a major operation No

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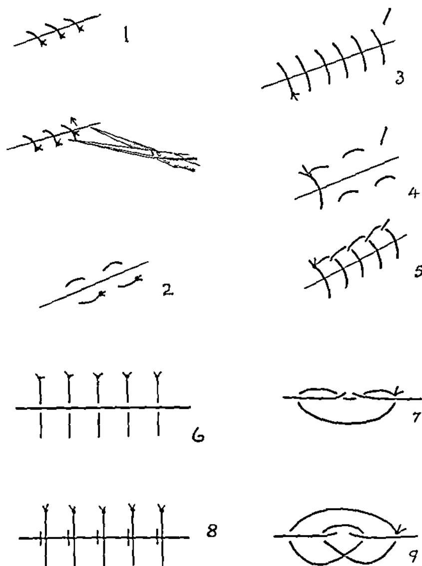


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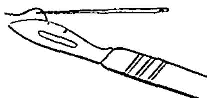


Fig 17 Cutting a Reverdin's pinch graft The skin is held up with the point of a needle and then the small cone of tissue removed with a scalpel

Fig 18 *A* Thiersch's razor for skin grafting *B* Gillies skin hook for retracting the edges of the wound to be grafted but without crushing it

Fig 19 Bodenham's modification of a Humby's skin grafting knife for taking split skin grafts The roller moves backwards and forwards whilst the graft is being cut The blades are replaceable

SKIN GRAFTING

Skin grafting is a method of securing more rapid healing of a denuded surface

The methods of grafting include the split skin method of Thiersch, the free full thickness graft of Wolfe, the pinch grafts of Reverdin, cross leg and cross arm flaps and other pedicle and tube grafts

The thinner split skin grafts are used mainly for large flat wounds such as result from burns The thicker split skin grafts are especially used for the face and flexor surfaces

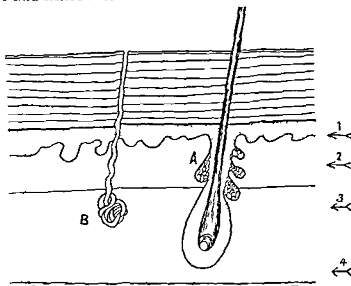


FIG 16 Diagram of the cross section of the skin

A Hair follicle and sebaceous glands *B* Sweat gland 1 The site at which a thin split skin graft is cut through the epidermis (Thiersch knife) 2 The site at which a medium thickness split skin graft (Humby knife) is cut 3 The site at which a thick split skin graft is cut through the dermis (Dermatome) 4 The site at which a full thickness skin graft is cut through the subcutaneous tissue (scalpel)

The free full thickness grafts are used for special areas such as the palm of the hand the sole of the foot and sometimes for the face and eyelids These grafts do not always take as well as the split skin grafts but when they do take the texture is better than with split skin grafts

Reverdin s pinch grafts usually result in ugly scars at both the donor and recipient areas and they are only used when extensive areas of skin have been lost or when it is desired to accelerate the healing of an ulcer in a situation in which the cosmetic effect is unimportant

Pedicle grafts are used over large tendons and over bony prominences or to fill in large defects of the subcutaneous tissues

Skin grafting from one individual to another may only be carried out if their blood groups are compatible but even then if the grafts do take this will not be permanent

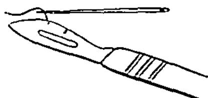


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FIG 18 *A* Thiersch s razor for skin grafting *B* Gillies skin hook for retracting the edges of the wound to be grafted but without crushing it

FIG 19 Bodenham s modification of a Humby s skin grafting knife for taking split skin grafts The roller moves backwards and forwards whilst the graft is being cut The blades are replaceable

The area which is to receive the graft must be healthy and as free from infection as possible or if it is an ulcer, it must have commenced to heal, as shown by the presence of a thin bluish red epithelial circle at its margin Hæmolytic streptococci, bacillus pyocyaneus and bacillus proteus must be absent as must any gross infection with staphylococci or other pathogens that is the wound must present firm granulations without any obvious pus After preliminary shaving, the surrounding skin should be cleaned with ethereal soap and water, followed by swabbing with ether The part is then covered with a sterilized dressing and secured in position by a bandage

Preparation of the donor site for skin grafting The area is shaved and then cleansed thoroughly with soap and water After washing off the soap the skin is prepared with ether followed by saline and is covered with sterile towels firmly fixed in place

Care must be taken that no antiseptic lotions, except alcohol, are used in the preparation of the skin, for any antiseptic not only lowers

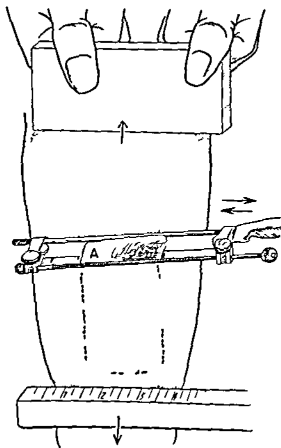


FIG 20 The Bodenham Humby knife cutting a split skin graft

the vitality of the young growing cells but also renders them more susceptible to invasion by micro organisms

The wound, if fresh or if curetted, must be free from blood, as a clot beneath a graft will prevent its apposition and ultimate union with the underlying raw surface

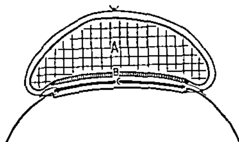


FIG 21 Diagram of a cross section of a split skin graft and its dressing

A Cotton wool containing just sufficient liquid paraffin or flavine emulsion to make it non adherent *B* Tulle gras *C* Split skin graft fixed with sutures The long ends of these sutures are tied over the cotton wool to exert slight pressure on and prevent movement of the graft

As soon as all the free grafts are in position they may be fixed as follows —

The graft is covered with a layer of tulle gras of the same size and is fixed in position on the wound by a series of interrupted sutures the ends of which are left long The graft and the tulle gras is then covered with several layers of cotton wool soaked in liquid paraffin or in flavine emulsion and the ends of the sutures are tied over the wool with sufficient tension so that the graft will not slip The whole dressing is covered with cotton wool and a crepe bandage is applied so that there is a light and even pressure over the graft (Fig 21) If applicable the affected part is immobilized by splinting

Another method of fixing the graft and of obtaining uniform pressure on it is by the use of dental impression compound An accurate mould is made of the area to be grafted, a thin coating of soft yellow paraffin (Vaseline) is applied to the mould The graft is then applied to the mould which is pressed down into its bed where it is firmly fixed with strapping or by other means This method is especially applicable to areas irregular in shape as between the fingers or on the external ear over surfaces that have movement such as the eyelids in the lining of relatively inaccessible areas such as the interior of the nose in the external auditory canal and about the mouth After seven or eight days the mould is removed and any overlap of the graft is gently excised

Complete and absolute rest of any grafted area must be secured until the graft has firmly taken If movement occurs between the graft and the wound it will fail to take

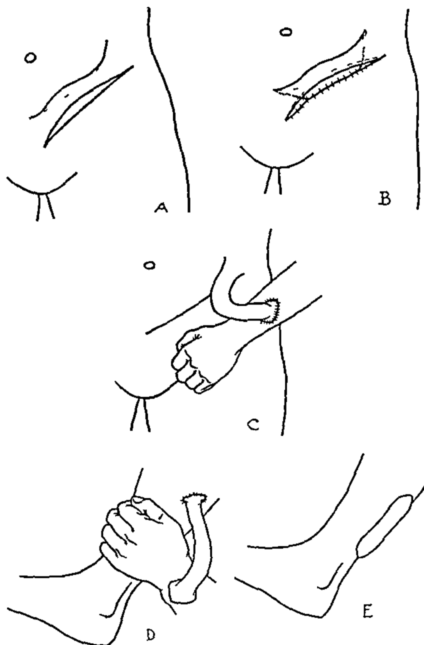


FIG 22 Diagrams to show the construction of a tube (pedicle) graft

A The incisions with the future graft raised from the abdominal wall *B* The bare surfaces of the graft and of the abdominal wall are closed by sutures *C* After the wounds of the graft and of the abdominal wall are firmly healed the lower end of the tube is detached from the abdominal wall and sutured to the wrist *D* When this wound is also firmly healed the tube is completely detached from its original site and is carried with the wrist to a new site where the graft is required it being then sutured to part of this area *E* When one end of the graft is firmly attached to the recipient area the other end is detached from the wrist and the graft is widely attached in its new site



FIG 23 A tube graft of the forehead which is being used here in the treatment of defects of the side of the nose and of the lower eyelids

The donor area on the forehead is completely covered temporarily with a split skin graft After the end of the tube graft has taken on the face and the defects have been replaced the remainder of the graft is reopened and then it is returned to the forehead



FIG 24 A cross leg flap The shaded area on the donor leg from which the graft has been raised is covered with a split skin graft.

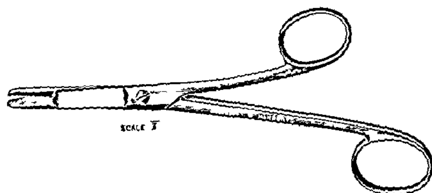


FIG 25 Gilles combined scissors and needle holder

With pedicle grafts the same principles apply as with free grafts, that is, the area to be grafted must be healthy and clean (if an ulcer, it must present firm granulations without any obvious pus), there must be no hæmatoma formation under the end of the graft, there must be no movement between the end of the graft and the recipient area, and contamination must be prevented In addition, there must be no pressure or tension on the tube itself

CHAPTER 7

SURGICAL NURSING OPERATIONS

Nasal Feeding Nasal feeding is employed when the patient is unable or unwilling to take sufficient food by mouth, and also as a method of treatment of peptic ulcer

A suitable apparatus consists of a glass funnel and tubing to which is attached a No 6 soft india rubber catheter

To ensure that the tube passes readily the patient should be in a sitting position with the head held level, and the tube, having been lubricated with olive oil is pushed, not upwards but directly backwards through the nostril for about fourteen inches The danger attending this process is that the tube may slip into the larynx instead

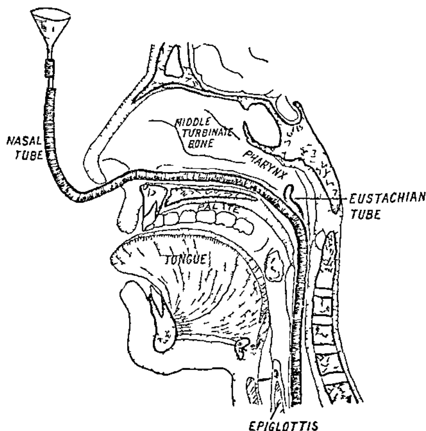


FIG 26 Diagram to show a nasal tube in position When a tube is being passed through the nose it should be passed directly backwards and not in a vertical direction

of into the œsophagus, then severe coughing and dyspnœa would be at once produced even in some unconscious patients

When the tube is in position in the œsophagus or stomach, the nourishment should be poured down in a slow steady stream so as to avoid stimulating the stomach and causing regurgitation

The food usually consists of milk eggs, dextrose and perhaps skim milk powder, it must be carefully warmed, measured and strained, and is usually about half a pint in quantity

When the prescribed amount has been given the catheter is dis connected and drawn out, the thumb being placed over the end to prevent the escape of the food still remaining in the tube

If the patient is co operative, the continuous drip method is often preferable to the intermittent The tube is passed into the stomach and the liquid food is given at a rate of 60 drops a minute or less If this rate is exceeded at first, the patient may complain of abdominal pains but in time he may tolerate a greater rate

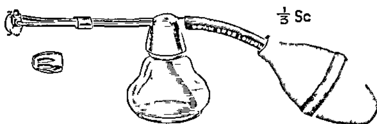


FIG 27 De Vilbiss postnasal and laryngeal spray The nozzle may be turned upwards or downwards

The continuous administration of an antacid such as Amphogel', by means of an intranasal tube passed into the stomach is occasionally employed to obtain continuous neutralization of the acid in the stomach thus giving a peptic ulcer a chance to heal

Instead of passing the tube through the nose it may be introduced through the mouth but that is less comfortable for long periods

Nasal Spray This may be effectively applied by means of an atomizer but care must always be taken to wash it through after use as it is liable to get clogged

The patient should sit up and lean forwards over a basin he is told to keep his mouth wide open and to breathe deeply this causes the soft palate to shut off the nose from the mouth and thus the fluid does not pass down the throat The nurse then gently sprays the lotion up one nostril and it returns by the other nostril

The old fashioned nasal douche causes a good deal of pressure in the nose and the fluid may be forced into the various air cells of the nose and even of the middle ear and it may give rise to acute inflammation

Syringing the Ear For this purpose a warm weak antiseptic solution and a clean glass or metal syringe are used

The patient with a towel tucked round the neck and a kidney dish held beneath the ear, is so placed that the ear is well illuminated The ear must be grasped with the left hand and pulled upwards and backwards so as to straighten the meatus The nozzle of the syringe is placed just inside the meatus, and the lotion is then injected slowly and gently along the upper wall of the external auditory meatus

After a plug of wax has been obtained as a result of the syringing the ear is dried out and then inspected with an auroscope to determine if any remains This examination and syringing is repeated until the meatus is clear

Insertion of Drops into the Ear The patient s head should be tilted so that the affected ear is uppermost, and then as in the syringing the external ear must be drawn upwards and backwards to straighten the meatus Before being dropped into the ear the drops are warmed by putting them in a teaspoon which has been sterilized in boiling water After they have been inserted the patient lies for ten minutes with the treated ear uppermost and the drops are worked inwards by pressing repeatedly but gently just in front of the ear

Irrigating the Conjunctival Sac, and Instilling Drops into the Eye See Chapter 34

Cleaning the Tongue and Mouth The routine cleaning of the tongue and mouth is carried out with small swabs of cotton wool firmly fixed in Howard Kelly or similar rachet forceps These swabs are dipped in a 12 per cent mixture of borax in glycerine

Mouth Washes The solutions commonly used are Glycerinum Thymolis Co (Glycothymoline) peroxide of hydrogen (2 5 or 5 Vols) a solution containing potassium chlorate (gr xxv) and glycerine (ʒi) to the ounce and a solution of sodium bicarbonate containing a teaspoon to the pint

Syringing the Mouth The patient is placed in a sitting position with the head bent forwards the mouth wide open and holds a medium sized kidney dish beneath the chin The nurse seats herself on a low stool close beside the patient and injects the cleansing liquid from below it is usually a saturated solution of boric acid diluted with an equal bulk of water and on each occasion two or three syringefuls are injected

For adults a four ounce glass syringe with an india rubber tube fitted to the nozzle is preferable but a Higginson s syringe is easier to manipulate and is therefore used in children The syringe used should be capable of being sterilized by boiling

With septic conditions of the gums the mouth may be syringed with hydrogen peroxide or with 1 in 1 000 acriflavine special attention being paid to all the pockets

Subsequently gauze soaked with acriflavine solution is lightly packed into the angle of the cheek and all round the gums and is retained in position for twenty to thirty minutes This procedure is repeated thrice daily, and is painless

After the syringing special attention should be paid to cleaning the teeth

Gastric Lavage The stomach may be washed out in cases of poisoning with various drugs in cases of persistent vomiting and as a pre operative measure

The apparatus consists of a ten ounce funnel and tubing to which is attached a medium sized œsophageal tube

If time allows, the oropharynx and the sensitive pharyngoœsophageal junction are rendered anæsthetic by sucking a pastille of amethocaine hydrochloride (Decicain) one grain twenty to thirty minutes before passing the tube The patient then sits up with the head slightly flexed and the tube, having been warmed and lubricated with glycerine, is passed to the back of the mouth until it meets the posterior wall of the pharynx down which it is gently pushed into the œsophagus The patient is told to breathe deeply and to swallow from time to time

The distance from the teeth to the stomach is 16 to 18 inches and as soon as the tube enters the stomach gas may escape with a gurgling noise through the funnel (which is held at a lower level than the stomach) By the contraction of the walls of the stomach the contents may fill the apparatus and be siphoned off

The funnel is then raised to the level of the chin and filled with warm Normal saline or weak sodium bicarbonate solution This will run *through the tube into the stomach but before it has all disappeared* the funnel is depressed and held over a pail, when the mixed stomach contents and lotion will siphon off

This process of siphonage is repeated several times until the return flow is quite clear

If the patient is unconscious a stiff rubber or a plastic tube should be guided down the pharynx by the left forefinger otherwise it may enter the larynx

Gastric lavage may also be readily carried out by passing a Jutte s Levin s or Wangensteen s tube through the nose into the stomach, and fixing it into position by strips of adhesive plaster applied to the face

The insertion of the tube will be greatly facilitated if after the tip has been passed into the nasopharynx the patient is given frequent sips of water from a feeding cup

With each gulp the tube is pushed a little further onwards until aspiration demonstrates that the stomach has been entered

This appliance does not interfere with the voluntary drinking by the mouth hence by using the tube as a siphon whilst the patient is drinking the ingested fluids are returned and the stomach irrigated

These tubes, as supplied by instrument makers, are long enough to hang over the side of the bed to below the level of the patient, and permit drainage of the stomach contents by siphonage, prompted when necessary by suction using an ordinary glass syringe

Duodenal and Intestinal Drainage Drainage of the duodenum and of the small intestine by an indwelling tube has almost entirely superseded enterostomy as a treatment for non mechanical or paralytic ileus

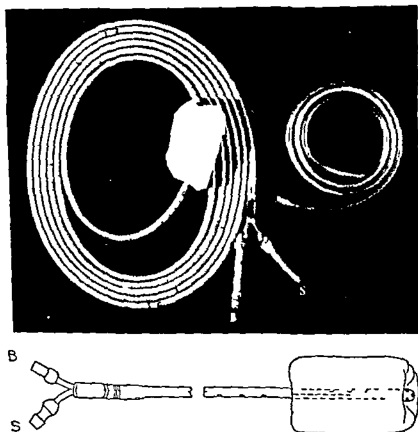


Fig 28 Miller Abbott s tube and Ryle s tubes
B The portion of the Miller Abbott tube leading to the balloon *S* The portion of the Miller Abbott tube to which suction is applied

Instead of intragastric suction an attempt may be made to pass a Miller Abbott or Cantor tube into the small bowel and to aspirate its contents

The Cantor tube (Fig 237) is 10 feet long and has a balloon filled with mercury tied to its tip

The Miller Abbott tube is also 10 feet long (Fig 28) It is provided with an inflatable balloon near the tip, and with holes for suction

both distal and proximal to the balloon When the balloon has passed through the pylorus into the duodenum it is inflated with air or water

Normally, the Miller Abbott tube should pass from the stomach to the duodenum and along the small bowel due to the peristaltic waves but if these are weak it may be difficult to persuade the end of the tube to leave the stomach When the contractions of the stomach and bowel are absent, this may be impossible

The fact that the balloon of the Miller Abbott tube has passed through the pylorus is confirmed by X ray examination

Ideally the tube should be changed every couple of days because the constant pressure exerted upon the inferior meatus of the nose is prone to cause ulceration However if a Miller Abbott tube is being used this is not possible In infants the continued presence of a tube in the nasopharynx may lead to an ascending infection up the Eustachian tubes and the onset of an acute otitis media

The most popular apparatus for providing suction to the gastric duodenal or intestinal tubes is that of Wangensteen and is described in Chapter 23

The fact that siphonage is actually taking place should be frequently verified and if the tube becomes blocked by mucus or *debris* it must be washed clean immediately

If the patient strongly objects to the indwelling tube a hypodermic injection of 10 8 mg morphia (gr $\frac{1}{6}$) may be administered every six hours Occasionally an injection of chlorpromazine (Largactil) will reduce the clamour on the part of the patient to have the tube removed

Duodenal or gastric drainage must be maintained until abdominal distension has entirely disappeared

Enemata Enemata are used to procure evacuation of the bowels, for the relief of pain to restrain diarrhœa and perhaps to introduce nourishment

EVACUANT ENEMATA are large in quantity they soften the fæces and so render evacuation easier, and the large bulk stimulates the bowel to contract

They usually consist of a pint or more of warm water alone or with about two ounces of soft soap

The enema ought if possible to be retained for at least ten minutes so that it may soften the fæces in the intestine

Previously a Higginson s syringe was used to pump the fluid into the rectum, but less force is exerted with a tube and funnel and it is safer

There is great skill in this little operation as is seen by the difference in the results obtained by various nurses

If the enema is not returned shortly after injection another small one may be given or it should be siphoned off with a rectal tube

A soap and water enema may be made more irritating by the addition of up to four drachms of turpentine

Two consecutive evacuant enemata are sometimes administered at an interval of one hour as a diagnostic test for intestinal obstruction

Three points should be noted concerning the return of the second enema, first the amount of fæcal matter evacuated second whether flatus is passed with or after the enema and third whether the enema is retained or returned without force

In intestinal obstruction the second enema may be retained or it may be expelled without force and without bringing away any flatus

NUTRIENT ENEMA In some patients who are unable to take sufficient nourishment by mouth an attempt may be made to increase the intake by the use of nutrient enemata However the absorption from the rectum and colon is slow and uncertain and repeated rectal injections are distressing to the seriously ill patient Also it is probable that substances more complicated than water salt glucose and amino acids are not absorbed from the rectum

OLIVE OIL ENEMA In cases of severe constipation where there is a difficulty in getting rid of the hard fæcal matter it is advisable to give an olive oil enema followed in an hour or later by a soap and water enema rather than exhaust the patient by repeated soap and water enemata

The oil is heated to about 95° Fahr by placing the container in hot water and from two to six ounces of olive oil are injected into the bowel by means of a catheter and funnel

GLYCERINE ENEMA In some cases an ounce of glycerine dissolved in an ounce of water is run into the rectum This causes a profuse secretion from the bowel which softens the fæcal matter so that evacuation is made easier

TURPENTINE ENEMA This is prepared by adding half an ounce of turpentine to a pint of soap and water

MAGNESIUM SULPHATE ENEMA This may be ordered in cases in which it is desired to produce slight dehydration e g after a head injury Six ounces of a 50 per cent solution or if this is too irritating eight ounces of a 25 per cent solution of magnesium sulphate (Epsom salts) in water is run into the rectum and retained for half an hour or longer if possible

Dressing Rectal Wounds The patient lies on the left side with the buttocks just over the right side of the bed and with the head down towards the knees A large piece of waterproof sheeting is placed under the buttocks and its edges are raised so that the irrigating fluid is directed into a bucket on the floor The previous dressing is removed with forceps and then the wound is irrigated with Milton eusol or Normal saline by means of a funnel rubber tubing and catheter (see Fig 261) The skin is dried and the wound is dressed by

one or more gauze squares about 2 inches in diameter These squares are moistened with eusol, Milton lotio rubra, etc, as ordered, and are laid on the wound The corner of one gauze square is inserted into the anus Wool and gauze combined pads are applied over the dressing and are fixed in place by a T-bandage

Colostomy Wash out This procedure is described on page 414

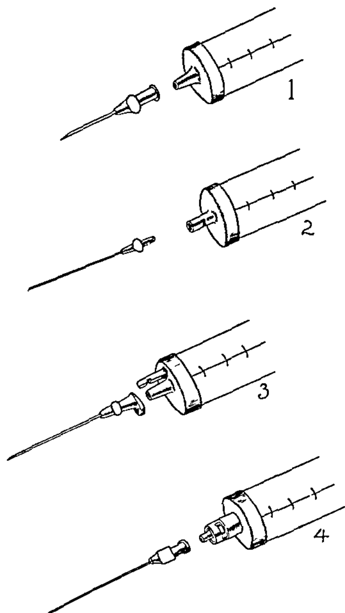


Fig 29 Diagrams to show the different fittings or mounts between syringes and needles

1 Record fitting 2 Bayonet fitting 3 Labat fitting and 4 Luer Lok fitting

Hypodermic and Intramuscular Injections

Hypodermic is derived from two Greek words meaning under the skin and subcutaneous derived from Latin terms has a similar meaning Drugs administered hypodermically are always highly concentrated and produce rapid effects unless the circulation is slowed

Stock solutions have the disadvantage that they soon become impure on keeping but this difficulty has been largely overcome by putting up material for hypodermic injections in the form of small tablets, or in small sealed glass ampoules Before giving a hypodermic injection the nurse must know the strength of the solution she is about to give, and she must be able to read a hypodermic syringe The syringe having been previously sterilized, is loaded with the required solution all air is expelled and the amount of the drug to be injected is carefully measured

A spot on the arm is selected where the skin is loose and free from veins, and it is cleansed by ether, methylated spirit or iodine A fold of the skin having been drawn upwards is pinched up between the thumb and forefinger of the left hand and then, with the right hand, the point of the needle is firmly thrust horizontally into the subcutaneous tissues at the base of the fold (Fig 30) Almost but not quite, the full length of the needle should be inserted in order that the injection may be as far from the skin puncture as possible and the fluid is slowly injected

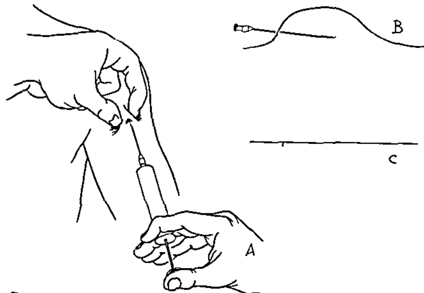


Fig 30 To show the method of holding the skin for a hypodermic injection

The skin is firmly pinched up *A* In this way the pain of the needle prick is less and the track of the needle s path is curved when the skin is released *B* The path of the needle when the skin is pinched up and *C* the same path after the needle is removed and the skin is released With a curved needle path the injected fluid is less likely to escape to the surface along the track

On withdrawing the needle a piece of sterile cotton wool is held over the puncture to prevent the escape of fluid The latter is disseminated by gently massaging the skin around the opening

It is easy to give a hypodermic injection, but it is frequently done imperfectly, the usual mistakes are to thrust the needle into the skin instead of into the subcutaneous tissues or to make the injection too close to the puncture and allow some of the injection to escape

If solutions of digitalis ergot bismuth or mercury are injected in the ordinary way, they are liable to form abscesses, hence these drugs should be injected deeply into the muscles in some such situation as the buttock The prone position is preferable and relaxation of the gluteal muscles should be obtained by turning the toes inwards

The buttocks may be divided into equal quadrants by a vertical and a horizontal (through the summit of the intergluteal fold) line, and the injection is made into the upper and outer quadrant near the intersection of the two lines (Figs 31 and 32)

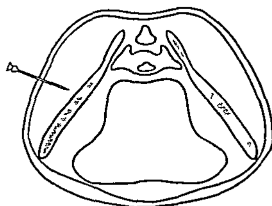


FIG 31 Diagram of a cross section of the pelvis showing the site of a needle for an intramuscular injection The point of the needle must not be allowed to come in contact with the bony pelvis

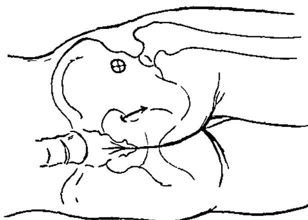


FIG 32 Diagram of the site for an intramuscular injection into the muscles of the buttock with the patient partly rolled over The line of the sciatic nerve is indicated by the arrow

This site is chosen in order to avoid depositing the irritant material on the periosteum or near the sciatic nerve

Abscess formation and induration may be caused through leakage and deposition of some of the injection material along the needle track hence suitable steps should be instituted to avoid this complication

After sterilizing the skin it and the superficial tissues are displaced downwards by exerting firm pressure with the left hand and the needle is then introduced to almost its full length by a single stroke

It is necessary to determine whether the needle has inadvertently entered a vein, and, if on slightly withdrawing the piston blood enters the syringe, the needle should be slightly withdrawn and the procedure repeated

The contents of the syringe having been slowly injected the needle is swiftly extracted and the superficial tissues are allowed to slip back into place The oblique curved valvular track left by the needle considerably reduces the risk of leakage of the injection fluid into the subcutaneous tissues

Infusion of Normal Saline Solution

Normal saline solution has many applications in surgery It was originally introduced as a substitute for the transfusion of blood in the treatment of hæmorrhage but it is now employed in cases in whom dehydration has occurred or is likely to occur and in whom sufficient fluid cannot be taken by mouth It is also used as a vehicle to dissolve various drugs used for inducing local anæsthesia

Normal saline does not damage the cells of the blood and it is called physiological or isotonic

When saline is to be used for intravenous injection it is usually purchased already sterilized and prepared in sealed flasks Part of the cap of the flask is removed to allow the tubing to be connected and then the saline is run into the vein through a needle or cannula The flow of the saline down the tubing is interrupted by a dropper so that its speed is apparent and it is regulated by an adjustable clamp The apparatus used for running the saline into the patient is known as a giving set

All tubing glassware needles cannulæ etc with which the saline comes in contact must be thoroughly cleansed and sterilized If it is not thoroughly cleansed before sterilizing any blood or other material will adhere during sterilization and will be dissolved off at the time of the next infusion This will result in a reaction that is, in a rise in temperature and pulse rate of the recipient who may also complain of malaise headache and rigors

The apparatus is most easily cleansed immediately after it is used It should first be washed through with running water and cleaned with a brush so that all visible particles are removed Then it is

washed through with at least three changes of pyrogen free double distilled water, assembled and wrapped in several layers of linen sterilized by heat, and stored in a dry place By " pyrogen free ' it is meant that the water does not contain any foreign substance that would produce a rise in temperature if it were injected intravenously Any apparatus to be used for infusions or transfusions must not be sterilized in a sterilizer containing alkali

Because of the trouble involved in cleaning the parts of a giving set there are now disposable plastic giving sets on the market Such sets have the advantages of being ' pyrogen free and are supplied sterile Their cost is about the same as the salary of the nurses for the time involved in properly cleaning and sterilizing the sets made of glass and rubber

Normal saline solution may be administered through a vein (Intravenous Infusion) through the subcutaneous tissues (Hypodermoclysis) into the marrow cavity of a bone (Intramedullary Infusion) and by way of the bowel (Rectal Infusion)

INTRAVENOUS INFUSION The cephalic or basilic veins in the forearm or the internal saphenous vein at the inner side of the ankle are usually selected for intravenous infusion and the skin over the vein is cleansed as for an operation

A sterile giving set and a sterile set of instruments for venesection as described in Chapter 12 are obtained

In addition a tourniquet will be required for the arm and a gauze dressing and bandage for the wound Catgut is used to ligate the vein and silk or cotton for the skin

It is usually possible to introduce the needle into the vein without making an incision but if it is not or if the patient is very restless the vein is exposed for about half an inch By means of an aneurysm needle two catgut ligatures are passed beneath the vein about half an inch apart the lower one is tightly tied as low down as possible whilst the upper one is left loose All air having been expelled from the tubing below the drip chamber an oblique opening is made with the scissors through half the lumen of the vein and then the cannula is inserted and fixed in position by tightening the upper ligature over it

If the patient is very co operative it may not be necessary to fix the limb In other cases the wrists or ankles are padded with cotton wool and then tied to the bed or the whole limb may be bandaged to a well padded splint which is fixed to the bed

If the fluid stops running it may be due to the position of the limb or to slight displacement of the needle or cannula If it does not restart after fully opening the clip adjusting the limb and the needle or cannula and after raising the flask the medical officer should be notified at once

If the medical officer is not available the puncture needle and the

air vent needle in the bottle should be checked for patency, remembering that they must be kept sterile If these two needles are found to be patent the tubing should be disconnected from the intravenous needle or cannula The blood or fluid should then run freely through the set, and if it does not, it is probably the filter that is at fault

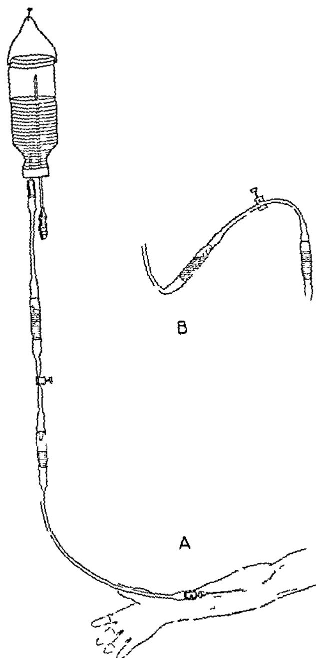


FIG 33 *A* Diagram of an apparatus for blood transfusion *B* To show how to lower the level in the drip chamber when it fills The glass tube containing the gauze filter is inverted and air flows over into the drip chamber

This should therefore be changed On the other hand, if the fluid does run freely through the set, the needle or cannula should be syringed with 2 ml of sterile saline or dilute citrate solution If the drip will still not run, it should be left in position and not removed Occasionally it will start again by itself but only if it is not clipped off See also Chapter 14

When sufficient fluid has been introduced, the needle or cannula is removed Usually a ligature will have been loosely inserted in the skin when the incision was made this is now tied and the wound is closed and dressed Any fluid remaining in the flask is discarded

The solutions in use for intravenous infusion include —

Normal saline,
5 per cent glucose in distilled water,
5 per cent glucose in Normal saline
4 per cent glucose in fifth Normal (N/5) saline,
Darrow s solution (potassium chloride, sodium chloride and sodium lactate in distilled water)
Ringer s solution,
4 28 per cent sodium sulphate in distilled water,
Distilled water

The usual rate of flow is from forty to sixty drops per minute or, roughly, an average of six ounces per hour

Further if 5 per cent dextrose solution is instilled at the rate of five ounces per hour for twenty four hours the total six pints of solution will yield approximately 675 Calories of energy

By intravenous infusion a normal individual can store and/or utilize not more than 0 8 g of dextrose per hour per kilogram (approximately 5¼ grains per lb) of body weight and all amounts in excess of this figure (owing to the elevation of the blood sugar above the level of the renal threshold) will be eliminated in solution in the urine

This fact must be taken into account when administering large volumes of dextrose solutions because the glycosuria induced excites a concomitant diuresis In other words a very rapidly given intra venous infusion of dextrose may increase the dehydration of a sick patient

Unless there has been a loss of salt by vomiting by sweating or from an intestinal fistula a solution consisting of 4 per cent dextrose in one fifth Normal (N/5) saline is that most frequently used In those cases in which it is necessary to give additional salt as shown by a decrease in the excretion of sodium chloride in the urine, every third or fourth flask of the dextrose and N/5 saline should be replaced by a flask of Normal saline

As long as the fluid enters the vein as a steady drip and the cannula is kept firmly fixed and immobilized there is little risk of the blood clotting either in the cannula or in the lumen of the ve

The nurse should keep watch for signs of œdema This soon produces swelling under the eyes or in the legs the amount of fluid entering the vein should then be reduced and any rise of the pulse rate or any respiratory symptom reported

SUBCUTANEOUS INFUSION This method is rarely used now as the amount of fluid that can be administered is very limited, the patient

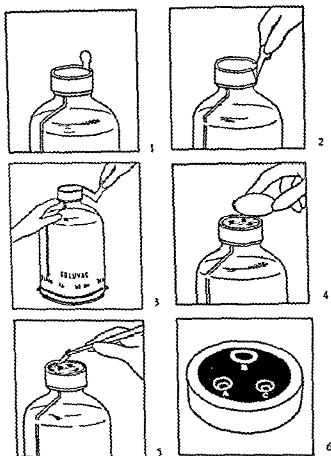


FIG 34 Diagrams of the Soluvac bottle The metal strip is torn down and then the metal collar and metal disc are removed The rubber sealing disc is removed aseptically following which an inrush of air will take place if the flask was not previously contaminated The giving set is connected to hole A B is the air inlet tube

is uncomfortable and especially in the debilitated patient it is liable to be followed by cellulitis

To aid the diffusion and the absorption of the fluid hyaluronidase may be added to the infusion fluid (saline)

The area chosen for the injection should be in a region free from large blood vessels and nerves and where there is loose connective tissue such as the thighs axillæ flanks or beneath the breasts

During the operation the temperature of the solution is kept constant at about 110° Fahr As a rule not more than half a pint of Normal saline is given at a time, for it is found that repeated small injections give better results than one large one When the desired quantity of solution has been introduced the needle is withdrawn and the puncture is then sealed with sterile cotton wool and collodion

Intraperitoneal Infusion Normal saline is occasionally given to very small infants by this route for the treatment of dehydration It is of no value in the treatment of shock

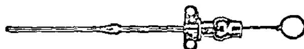


Fig 35 Hamilton Bailey s intravenous cannula

Intramedullary Infusion Because of local trauma in cases of severe burns or extensive injuries it may be extremely difficult or impossible to locate a suitable subcutaneous vein In infants the veins are always small and after several previous infusions or trans fusions it may be very difficult to find one that is patent

After giving a sedative the local anæsthetic is then applied over the site of the puncture and the periosteum carefully infiltrated—the tibia in a baby the sternum in an adult—and a needle is inserted into the marrow cavity When in place the needle is filled with either Normal saline or citrate solution by means of a syringe and it is then linked with the transfusion or infusion unit for blood, plasma or Normal saline as the case may be In the adult a sternal puncture needle (Fig 211) is most convenient but in the absence of a special needle a strong lumbar puncture needle suffices in the baby a strong needle of the type used for administering blood intravenously in adults is suitable The needle must be surrounded with a sterile dressing and must be firmly fixed with adhesive plaster

Rectal Infusions Rectal infusion is a slow and less effective method of introducing fluid into the circulation but it has the advantage of simplicity requiring no preparation of the patient and but the simplest form of apparatus

The equipment need not differ from that used in giving an ordinary enema The patient is placed in the lateral or dorsal position with the hips elevated The rectal catheter is passed in the usual manner and the reservoir filled with tap water at a temperature of 110 Fahr is raised from two to three feet when the required amount of fluid is slowly introduced

The amount of infusion should usually be about half a pint and this quantity may be given every four hours Sometimes a pint can be retained without difficulty

As Murphy (who originated this method) has said "The flow must be controlled by gravity alone, so that when the patient endeavours to void flatus or strain, the fluid can rapidly flow back into the can otherwise it will be discharged into the bed"

Blood Transfusion

A review of the literature of blood transfusion shows that the practice was one of antiquity It is referred to in the writings of the ancient Egyptians and is said to have been carried out in the time of Columbus Attempts to transfuse the blood of animals into humans resulted in disaster to both patient and physician Similarly, severe reactions and death often followed transfusion of blood from one human being to another

Blood transfusion had to await the discovery of blood groups by Landsteiner who found that there were four main types of human red cells namely O, A, B, and AB Safe transfusion dictates that patients receive their own blood group with the exception that group O blood can be given safely to any patient since there is no agglutinin for group O cells in the blood of the recipient Bottles of blood must be clearly labelled with their Group

If an incompatible transfusion is given the patient will complain of pain in the loins and nausea and will appear anxious The temperature may rise rigors will occur, the urine will contain hæmoglobin and if the transfusion is continued suppression of urine (anuria) will occur due to blockage of the renal tubules

The later discovery of the Rh factor by Wiener added another safety factor Subsequently a number of other antigens have been discovered

Prior to the introduction of citrate to prevent the clotting of blood all transfusions were given by the so called direct method

DIRECT METHOD (ARM TO-ARM METHOD) Here a needle in a vein of the donor is connected to a cannula in a vein of a recipient by means of rubber tubing and then the blood is milked along the tubing to the recipient by means of a pump on the rubber tubing This method gives the patient unaltered blood but it is more liable to complications than the indirect method

The introduction of citrate by Agote and Lewisohn afforded a safe means of preventing the clotting of blood for long periods after collection This made possible the indirect method by which blood could be collected from donors over a wide area

The ability to keep blood without clotting for long periods made it necessary to study the preservation of the several components of blood

Plasma is little altered by the addition of citrate The factors responsible for clotting remain unchanged as do those which are

responsible for the osmotic properties of the plasma When citrated blood is transfused the citrate is rapidly metabolized and it has no permanent effect on the ability of the blood of the recipient to clot normally During the war methods were developed for drying plasma and reconstituting it just prior to infusion Millions of units of dry plasma were used by the Armed Forces Plasma, however, is never a complete substitute for whole blood since it does not provide red cells

RED CORPUSCLES The human red cell circulates in the blood stream for about 120 days It derives the energy for its main function, namely, the transport of oxygen and carbon dioxide from the utilization of glucose When blood is collected into a citrate solution, its supply of glucose is cut off enzymatic processes slow down and the cells rapidly lose their viability As a result when stored blood is transfused, some red cells have been irreparably damaged and are removed from the blood stream The percentage of non viable cells increases with the length of storage A safe transfusion must contain not less than 70 per cent of viable red cells which remain in the blood stream and do their job Citrated blood is not safe to use after five days of storage As a result whole blood could not be transported overseas during the early part of the 1939–1945 war

Loutit and Mollison developed a solution known as acid citrate dextrose in which red cells remain viable for longer periods so that whole blood can be safely transfused up to 21 days after collection provided it is kept under constant refrigeration at 4 to 6° Cent This solution made an overseas whole blood programme possible and about a million units of whole blood were administered to casualties in the various theatres of war This solution is in general use today in civilian practice and is largely responsible for the enormous increase in the number of blood banks throughout the civilized world

For the earliest indirect transfusions blood was collected through rubber tubing into open vessels which were stoppered with cotton wool plugs Then prior to giving it was filtered through gauze These open procedures involved a serious risk of bacterial contamination, and severe reactions often occurred During the war bottles with self sealing rubber stoppers were employed together with giving sets containing metal mesh filters Later a method of producing an evacuated bottle was developed and since no venting is then required for collection the danger of contamination is greatly reduced It is however not completely overcome for the outer surface of the stopper is a potentially contaminated area This danger of contamination is enhanced by the Gram negative bacteria which flourish in refrigerators at temperatures between 0 and 10 Cent These bacteria produce a virulent endotoxin and they have been responsible for many fatal reactions

The collection of blood into bottles is accompanied by a great deal of frothing and turbulence which in itself initiates the deterioration of red cells

These hazards have been overcome to a great extent recently by the introduction of plastic blood transfusion equipment, but unfor-

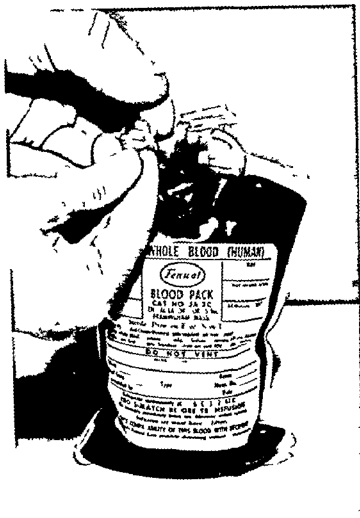


FIG 36 Plastic blood pack for the collection and storage of blood It is to be noted that this pack readily collapses as the blood runs from it and thus an air vent is unnecessary

tunately the cost of the plastic bags for collecting and storing the blood is high and their use is still restricted However as mentioned above cleaning and sterilizing a giving set is a time consuming process and there is the danger that these processes will be inefficiently carried out For these reasons and with the present high cost of labour the plastic disposable giving sets themselves are quite often used

When taking blood from a donor into the complete plastic trans fusion equipment the blood is collected through a plastic tube into a bag made from a transparent, flexible plastic material but, as the bag contains only the anti coagulant solution, frothing and turbulence are eliminated The surface characteristics of the plastic used are

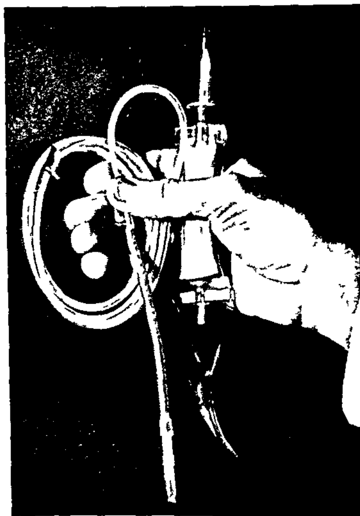


FIG 37 Fenwal plastic giving set for blood transfusion

slightly less injurious to red cells than glass surfaces and therefore the red cells are better preserved in the plastic bag

The plastic giving set has a coupler which like the outlet port of the bag has a protective cover which is only removed immediately prior to use The coupler which is the spiked upper tube on the top of the filter chamber and which is inserted into the vessel containing the blood and the needle are both protected against contamination by a snugly

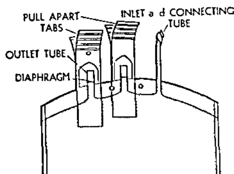


FIG 38 The top of the blood pack depicted in Fig 36 There are two sterile outlet ports with pull apart tabs The inlet and connecting tube is used for the collection of the blood

fitting cover This is easily removed by pushing down and turning

The filter may be made of nylon gauze with a large filtration surface which prevents stoppage of flow during administration A drip chamber is incorporated in the filter set to permit visualization of the rate of flow

The plastic equipment also offers the advantage that when blood must be given quickly, this can be accomplished by exerting pressure on the bag manually or mechanically Rapid transfusion from a bottle necessitates the entry of air under pressure with the danger of air embolism but this cannot happen with the plastic bag

Plasma may be separated from the red cells in the plastic bag with the minimal danger of contamination The red cells are separated by allowing to settle by sedimentation or by spinning in a centrifuge A smaller plastic bag is then connected through the outlet port of the collection bag and by the application of gentle pressure to the latter the plasma is then transferred to the smaller with no risk of contamination This procedure makes the preparation of packed cells much easier and thus it is possible to give practically only red cells to patients who require a rapid increase in their hæmoglobin without overloading their circulation The plasma obtained in concentrating the red cells is conserved for use in other cases or for drying or fractionation

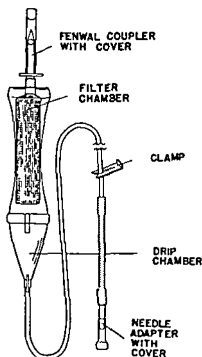


FIG. 39 Diagram of the plastic giving set depicted in Fig 37

Dacal Lib

A similar technique permits the harvesting of platelets for administration to patients with thrombocytopenia The bag containing the platelet bearing plasma is again spun down in a centrifuge, the plasma is transferred to another bag and the concentrated platelets given This procedure makes it possible to give the platelets from many pints of blood to the one patient

No matter what type of vessel is used to hold the blood, under no circumstance must the blood be heated over 40° Cent (104° Fahr), otherwise it will produce serious reactions in the patient It is much more dangerous to give overheated blood than blood which is cool

The rate at which the blood is given depends on many factors In the patient in whom there has been a sudden loss of a few pints of blood *e g* after a gunshot wound of the femoral artery, the transfusion will be given as fast as possible for the first one or two pints If necessary the rate of flow will be aided by increasing the pressure in the bottle containing the blood by a valve syringe, such as a Higginson s or on the tubing by means of Julian Smith's pump If a plastic bag is used to hold the blood the pressure may be increased by compression of it In other cases a slower rate of flow is sufficient a rate of about 60 drops a minute being often used

If the drip chamber fills it may be lowered as shown in Fig 33, without disconnecting the tubing and without injecting air into the set If a plastic giving set is being used and overfilling of the drip chamber occurs this chamber should be squeezed by hand to expel the excess blood back into the bottle and then air is allowed to pass over into the drip chamber

Catheterization

For practical purposes catheters may be regarded as being made of rubber, metal and gum elastic The latter is made of silk and coated with a mixture of rubber and varnish

The sizes of catheters are measured according to two gauges the English and the French The French scale runs from No 1 to No 30

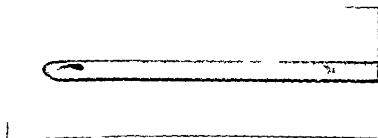


FIG 40 Jaques rubber catheter Other catheters are illustrated in Figs 279 to 286 Figs 288 to 290 and Fig 294

the No 1 having a diameter of ⅓ millimetre and the No 30 a diameter of one centimetre The English scale runs from No 1 to No 16 and is more or less arbitrary, roughly speaking a catheter number in English corresponds to twice that number on the French scale (See Fig 40 Figs 279 to 286, and Figs 288 to 290)

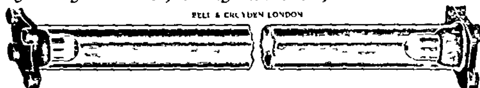


FIG 41 Sterilizing tube for ureteric catheters This tube is 32 inches long and is provided with rubber bungs and glass receptacles for holding paraform tablets

THE INDIA RUBBER CATHETER *e g* Jaques, is soft and flexible and is usually selected to empty the bladder, when there is no obstruction in the urethra The tip of the catheter beyond the eye may be solid and the proximal end should be trumpet shaped

It can be sterilized by boiling After use any oil or grease is removed from the catheter which is then washed, sterilized, carefully dried and put away in a little French chalk

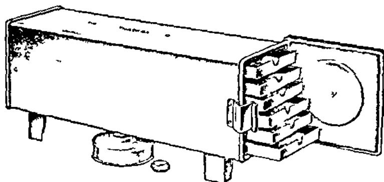


FIG 42 Formalin catheter sterilizer and spirit burner

ENGLISH GUM ELASTIC CATHETERS are less flexible than the French and can be changed into a stiff catheter by the introduction of a flexible wire—the stylet

After use a stream of water is forced through the catheter by a syringe or by attaching it to an apparatus which is fixed to a water tap and all grease and blood clot, etc are removed from its surface

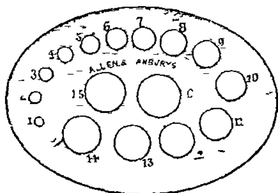


FIG 43 English catheter gauge

Various methods have been introduced for the sterilization of gum elastic catheters, but the two chief are the biniodide of mercury method and the formaldehyde In the former the catheter is placed in 1 in 4,000 biniodide solution for 30 minutes

Formaldehyde vapour is also used for flexible catheters and is specially useful when a large number of instruments are to be sterilized This can be carried out in hospital in special ovens or sterilizers For private practice one may use a glass tube of sufficient length to take a bougie or catheter The ends of the glass tube are closed by rubber stoppers into one of which is inserted a perforated receptacle for carrying paraform tablets Gum elastic catheters should be stored dry and preferably dusted with a little French chalk or lycopodium powder

The frequent cleansing and sterilization of catheters is apt to make them rough or cracked and a cracked catheter must never be used as it may be broken off inside the bladder

Gum elastic catheters will *not* stand boiling for more than one or two minutes

METAL CATHETERS have a curve corresponding to that of the urethra a blunt conical end and two small metal loops at the proximal end to enable the instrument to be tied into the urethra if so desired

Like other metal instruments they are sterilized by boiling etc

SPECIAL CATHETERS The *Coude* and *Bi Coude* also known as single and double elbowed catheters are stiff instruments with the ends bent upwards and are used in cases of enlargement of the prostate gland

A Silver Prostatic Catheter is a special metal instrument having an extra large curve

Double Way Catheters have an inlet and an outlet tube and may be used for washing out the bladder

Female Catheters are made of glass or silver and can be sterilized by boiling etc

TECHNIQUE OF PASSING A CATHETER IN A MALE A ward trolley with the following articles should be placed alongside the patient — A sterilized soft rubber full sized Jaques catheter, swabs in a bowl, sterilized towels catheter lubricant and a receiver to collect the urine The lubricant may be sterilized paraffin or some special catheter lubricant such as KY jelly or Lubafax

Oils and fats should not be used as they form an adherent coating on catheters which may not be dissolved by sterilizing processes and acts as a protective covering for germs

All being ready the patient is placed in the dorsal position and the glans penis and the meatus are thoroughly cleansed by dilute Dettol or other suitable antiseptic

The great essential in passing a catheter is that the technique adopted must be aseptic Also catheterization may be practically painless if properly performed If necessary the urethra may be tized

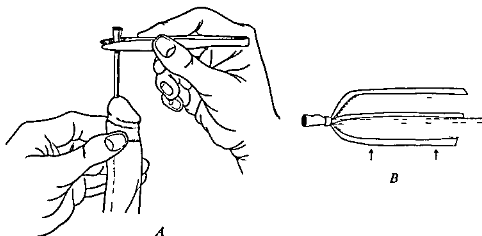


FIG 44 *A* The technique for passing a urethral catheter in the male

The external meatus and glans are thoroughly cleansed and the lubricated sterile catheter is held in sterile forceps Note that the penis is held taut to straighten out the urethra This greatly facilitates the passage of the catheter If there is much difficulty in passing the catheter the urethra should be injected with warm sterile olive oil

B Diagram of a method of tying in a catheter in the male

The outline of the penis and urethra are represented by the interrupted lines Tapes are fixed to the catheter near its end and adhesive strapping is applied around the penis outside the tapes at the sites indicated by the arrows Nowadays however a Foley s catheter is more often used when the catheter must be retained for some time Fig 294

One drachm or more of 4 per cent procaine hydrochloride is injected into the urethra and retained for at least ten minutes

The penis is then held upright and the catheter, having been lubricated is slowly fed into the urethra If the catheter becomes obstructed the penis should be put on the stretch to obliterate any folds in the mucous membrane, and the instrument is then again advanced In this way it can usually be made to enter the bladder

In withdrawing the catheter the instrument should be compressed between the index finger and thumb, or the tip of the finger should be placed over the end so that the urine in the catheter will not drip out and wet the patient s clothes

In cases of retention of the urine only a small amount is drawn off at first Sudden evacuation of the urine in these cases is apt to be followed by suppression of urine or by hæmorrhage from the mucous membrane of the bladder or kidneys owing to the sudden relief of pressure on the distended veins

INDWELLING CATHETER If urinary infection is to be avoided an indwelling catheter demands the strictest aseptic regime before passage the penis with retracted prepuce is well washed dried with a sterile towel the glans penis swabbed with dilute Dettol and the urethra washed out with oxycyanide of mercury solution (1 in 5,000)

Subsequently, the tip of the penis and the emergent portion of the catheter are surrounded by a sterile gauze swab soaked in glycerine or other suitable antiseptic and this is changed at least twice daily

The catheter having been passed in the usual manner, is retained by tying a piece of tape firmly around it about 2 inches from the urethral orifice, the two ends of the tape are then passed over the swab to the sides of the penis to which they are strapped by adhesive plaster 1 inch wide and 5 inches long encircling the organ just posterior to the glans The ends of the tape are turned back and securely fastened by a fresh piece of adhesive plaster which again encircles the penis (Fig 44)

The proximal opening of the catheter may be occluded by a sterilized spigot which is removed every six hours or it may be connected to a rubber tube which is led down to a large jar under the bed containing coloured antiseptic solution below the surface of which the end of the tube dips Alternatively a Dukes' apparatus may be employed (Fig 269) If such an apparatus is not being used the bladder should be washed out through the catheter twice daily with 1 in 10 000 oxycyanide of mercury solution no more than two or three ounces of lotion being run in at any one time The catheter must be changed at least twice weekly

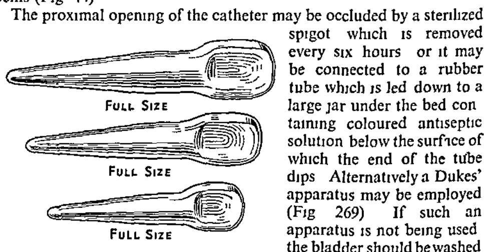


FIG 45 Catheter spigots glass in three sizes

To avoid removing the adhesive plaster surrounding the penis the tapes should be cut close to the catheter and on reinsertion of another instrument a second piece of tape about 6 inches long is tied around the fresh catheter about 2 inches from the urethral orifice as before The two extremities of the second tape are then tied to the cut ends of the old tape over the gauze swab covering the glans penis

The Foley catheter (Fig 294) is a double lumen rubber catheter with a small balloon fixed around the end of the catheter just behind the opening This catheter is passed into the bladder in the usual way Then the balloon is distended with fluid and the part of the catheter leading to the balloon is clamped off The distended balloon prevents the catheter s being withdrawn

CATHETERIZATION IN THE FEMALE Catheterization in the female should always be done by direct sight for the old method of passing a catheter by touch carries with it the greatest risk of infection

The patient is placed on her back with her knees slightly drawn up and then the external genitals are thoroughly cleansed with soap and water and Dettol solution The nurse stands on the right side of the patient, and separates the labia with the thumb and forefinger of the left hand so as to expose the meatus Then with the right hand, the catheter can be readily introduced along the urethra into the bladder

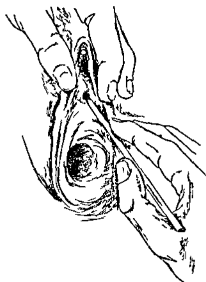


FIG 46 The passage of a catheter in the female

The labia are held aside with the left hand and after the external urethral meatus and vulva are cleansed a lubricated sterile catheter is passed

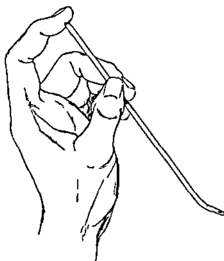


FIG 47 The end of the catheter is blocked with a finger whilst it is being removed In this way the urine in the catheter is not spilled

Washing out the Bladder

This procedure is occasionally called for in cases of chronic cystitis hæmorrhage etc and as a preliminary to instrumental examination or to operative interference There are two methods—

SIPHONAGE, OR SINGLE CATHETER METHOD where fluid is injected in sufficient quantities to distend the bladder

DOUBLE FLOW CATHETER METHOD where the fluid escapes as fast as it flows in

In the majority of cases siphonage is preferable as a certain amount of distension of the bladder is necessary to wash out pus bacteria and *debris* from the folds of the mucous membrane

Various solutions are employed for washing out a bladder The most commonly used are —Normal saline boric acid (up to 10 grains to the ounce) oxycyanide of mercury (1 in 10 000 to 1 in 2 000) silver nitrate (1 in 15 000 to 1 in 5 000) and mercurochrome (1 per cent)

The instruments required for this operation are a large glass funnel four feet of rubber tubing a soft rubber catheter a glass junction, a pint glass measure a thermometer and a waste pail

Subsequently, the tip of the penis and the emergent portion of the catheter are surrounded by a sterile gauze swab, soaked in glycerine or other suitable antiseptic, and this is changed at least twice daily

The catheter, having been passed in the usual manner, is retained by tying a piece of tape firmly around it about 2 inches from the urethral orifice, the two ends of the tape are then passed over the swab to the sides of the penis to which they are strapped by adhesive plaster 1 inch wide and 5 inches long encircling the organ just posterior to the glans The ends of the tape are turned back and securely fastened by a fresh piece of adhesive plaster which again encircles the penis (Fig 44)

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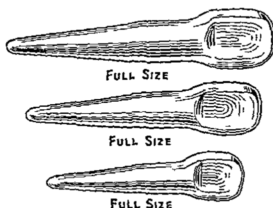


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CHAPTER 8

SURGICAL TECHNIQUE

MODERN surgical technique has grown following an article by Lord Lister which appeared in *The Lancet* in 1867 In this article he proved that suppuration of a wound was due to the presence of bacteria, and that if these could be excluded or killed suppuration would not take place

To avoid suppuration Lister elaborated certain rules but these were based on the free use of strong antiseptics designed to kill bacteria or inhibit their growth Since then experience has taught that not only are some of these antiseptics comparatively inefficient owing to their interaction with the albumins of the body (*e g* perchloride of mercury) but owing to their destructive action they actually lower the resistance of the tissues against subsequent infection

Most surgeons now limit the use of antiseptics to the disinfection of certain instruments and of the skin of the patient and the surgeon s hands They rely on heat sterilization of most materials brought directly or indirectly into contact with the wound

The general principle underlying modern surgical technique is that practically all infection of wounds is derived from without, and not from infection *via* the blood stream The latter is only likely when a hæmatoma has been allowed to form in the wound

The common paths by which micro organisms can gain access to an operation wound are *via* the clothes or skin of the patient, the surgeon or his assistants the atmospheric air or the instruments, sutures, lotions dressings etc that are used in performing an operation

Owing to the impossibility of thermal sterilization and the inaccessibility to antiseptics of the numerous bacteria infesting the cracks and pores of the skin bacterial sterility of the skin has not yet been attained in practice

Clothing dressings etc on the other hand are made of material that permits of sterilization by heat

PREPARATION BEFORE OPERATION

Surgeons and Nurses PERSONAL CLEANLINESS Those concerned with the operation should be clean as regards their daily toilet

CLOTHING *Gowns* of linen or calico not nylon suitable for repeated thermal sterilization should be worn by the surgeon and nurses Gowns should reach from the chin to the ankles and fasten down the

The operation must be carried out with full aseptic precautions The apparatus is boiled and the thermometer sterilized by immersion in 1 in 500 perchloride of mercury solution

After cleaning the external genitals, a full sized soft rubber catheter is gently passed into the bladder and any residual urine is allowed to escape The funnel tubing is then filled with lotion and the tubing attached to the catheter, first taking care that all air or cold solution has been expelled The funnel filled with the lotion at a temperature of *100° to 105°* Fahr, is then raised one *to two feet above the level* of the bladder and the solution allowed to flow slowly into and distend the bladder

As soon as the patient complains of distension the funnel is lowered below the level of the bladder and a mixture of urine and lotion flows back into the tubing and is allowed to escape into the waste pail The funnel is then refilled and raised and this process is repeated until the returning fluid is clear

Vaginal Douche

Vaginal douching may be used for simple cleansing purposes or as a preparation for operative treatment

The apparatus required consists of a metal irrigating can, a ther mometer six feet of rubber tubing a glass vaginal douche nozzle and a douche pan with a spout to which is attached a piece of tubing sufficiently long to convey the return fluids to a waste pail The *vaginal nozzle should be straight and have all the perforations at* the sides and none at the end, so as to avoid directing the solution against a patulous cervix

The apparatus should be sterilized by boiling and the thermometer sterilized by immersion in 1 in 500 perchloride of mercury

The commonest solutions used for vaginal douches are —Normal saline permanganate of potash 1 in 1 000 thymol 1 in 1,000, liquor iodi mitis (half a drachm to the pint) and Dettol 0 5 per cent

Under ordinary circumstances the douche is given at a temperature of 105° Fahr but when the vasoconstrictor effect of heat is required the temperature should be raised to 120 Fahr

The patient lies in bed in the dorsal position and on a douche pan, and the labia are separated with the fingers of the left hand, as in the introduction of a catheter The douche can is placed at an elevation of about three feet and after all air has been expelled from the apparatus the nozzle is introduced into the vagina The vagina balloons up under the pressure of the fluid and thus allows the solution to come into contact with its entire surface

In cases of relaxed vagina however this does not occur the vagina outlet is compressed against the nozzle but this should be applied with great caution in puerperal cases as some of the solution could then be forced into the uterus



FIG 50 The method of picking up a sterile gown after scrubbing up It will be noted that the gown had been turned inside out and folded so that its top was on the outside



FIG 51 Both hands are inserted into the sleeves of the gown simultaneously

therefore not be used on the hands or gloves in the operating theatre To ensure free passage of the steam inside the gloves a pack of lightly folded gauze is placed in each of them

Each glove is wrapped separately without wrinkling, in gauze or a towel and placed in the sterilizing drum

If a pressure higher than 10 lb per square inch is employed, the gloves tend to perish, even high grade gloves having only a relatively short life

About seven or eight operations may be expected from a good brand of rubber gloves

Some surgeons do not wear gloves for eye operations or for operations on the ear nose and throat

Every one who enters the theatre during an operation should change his footgear or have it covered so that no mud and road dust will be carried into the theatre

Rubber sea boots with loose tops into which the trousers can be tucked are worn by some surgeons but as these are frequently soiled with blood or pus etc some arrangement must be made to secure their adequate sterilization unless this can be carried out it would be better not to use them at all Canvas over boots are provided outside many operating theatres and these are more easily sterilized than rubber boots If these are not available the nurses should wear clean white rubber shoes

The greatest care must be devoted to rendering the hands and arms as clean as possible for of all the details in the preparation for an operation none equals in importance that of the cleansing of the surgeon s and nurses hands

back The sleeves should have cuffs which can be tucked inside the wrist band of the rubber gloves

A sterilized linen cap, which covers all the hair, prevents the infection of an operation wound or the instruments by falling hair, dust, scurf, etc



FIG 48 Diagram of a gauze mask with tapes

The interrupted line represents the opening of the pocket on the back of the mask into which a piece of plastic material or paper is placed

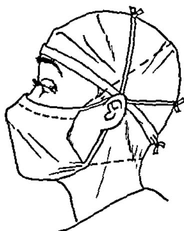


FIG 49 One method of fixing the gauze mask Alternative routes for the tapes are shown by the interrupted lines around the head

The surgeon, nurses and all in the theatre should wear masks over the nose and mouth to prevent infection from coughing sneezing talking etc

It must be clearly understood, however that a four fold gauze mask does no more than arrest the gross splash of a cough or sneeze and it does not protect against 'droplet infection in the sense of the more numerous small particles expelled during ordinary speech

For a permeable mask to be germ proof no fewer than 16 layers of gauze are necessary but an impermeable mask may be made with a thin layer of cellophane inserted between a double layer of gauze (Fig 48)

The hands are covered with rubber gloves but these must not become an excuse for inefficient disinfection of the hands since the preparation of the hands should be the same lest a glove is punctured The medium thickness of glove is the best for general use, and it should fit closely but, at the same time not too tightly or the fingers soon become cramped

Different methods of sterilization of gloves are favoured by various surgeons the most generally adopted being the use of an autoclave at a pressure of 10 lb per square inch for thirty minutes (the dry' method)

In the latter method the glove must be well powdered with talc both inside and outside to prevent the rubber surfaces from sticking together The talc used on the gloves and on the hands should be a special preparation such as BioSorb, which is non irritating to the tissues The ordinary talc for toilet use will cause adhesions if it is allowed to come in contact with the peritoneum and it should



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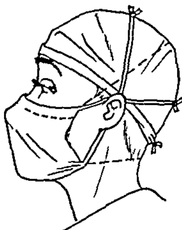


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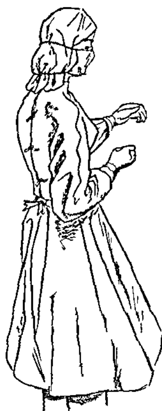


FIG 55 Nurse prepared for operation

The mask is over the nose all the hair is covered the gown is over lapping at the back and the hands are being held up in front of her She would be wearing canvas boots

It has often been shown that prolonged or frequent exposure of the hands to contamination readily converts them into chronic carriers of virulent organisms Hence the importance of frequent and thorough hand washing should be impressed upon every nurse and student

Transient bacteria lie on the surface or are loosely attached thereto by fats or dirt, and may be removed or killed with comparative ease

On the other hand resident bacteria are more firmly attached and are difficult to remove or kill either by detergents or germicides Transient flora may contain any number of pathogenic bacteria resident flora relatively few as a rule

The best method of cleaning the hands is scrubbing with soap and water with a stiff brush

The nails must be cut short and all frayed skin and hang nails removed After preliminary scrubbing a sterile cap and mask is put on The hands and arms are thoroughly scrubbed for at least another five minutes in water as hot as can be borne and using a sterilized

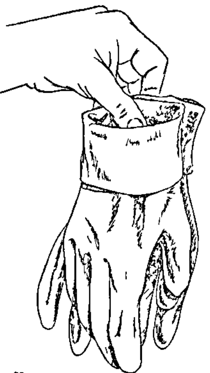


FIG 52 A pair of sterile powdered gloves are being held together with their thumbs pointing forwards Note that the cuffs of the gloves have been well turned down before sterilizing

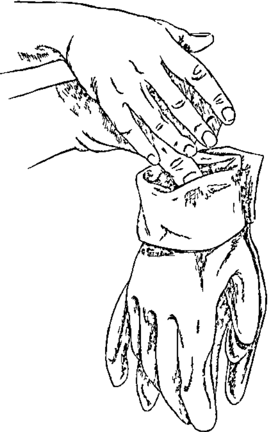


FIG 53 The right hand is slipped into the right glove whilst the left hand holds the insides of both cuffs

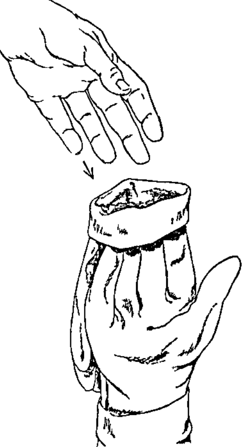


FIG 54 The gloved right hand then holds the left glove under the cuff whilst the left hand is inserted Thus the outsides of the gloves are not touched by a bare hand

In practice, a purgative should only be given before operation if it is especially ordered and the same applies to enemata

Radiography has demonstrated that after the administration of a full pharmacopœial dose of castor oil the colon becomes flaccid and does not recover its normal mobility for two or three days

The patient has a light supper on the previous evening and, provided the operation is to be performed early in the morning has nothing more to eat or drink except a cup of tea more than four hours beforehand The necessity of having the stomach empty during an anæsthetic is discussed in Chapter 13

The fats are usually reduced to a minimum and carbohydrates are given to excess often in the form of sweetened fruit juice, as a pre operative measure to lessen post operative acidosis

The skin of the operation area must receive very careful preparation Various methods have been described but they all depend on (i) shaving (ii) washing (iii) the removal of fat, and (iv) antiseptics

On the day of operation the nurse who is undertaking the preparation, after having thoroughly scrubbed her hands should wet shave the operation area in order to remove the hair and the surface epithelium The part is then thoroughly washed with ethereal soap and warm water for ten minutes and particular attention must be paid to all parts where the skin is not on the stretch, *e g* the umbilicus folds of the groin scrotum, axilla etc The best material with which to wash soft skin is sterile gauze but a nailbrush should be used for all patches of rough or hard skin such as the hands feet and knees The skin is then dried with sterile gauze and covered with a sterile dressing which is firmly fixed in place with a bandage and adhesive strapping

Occasionally especially in orthopædic cases the skin will be cleansed and covered with a new sterile dressing daily for two or three days before operation

On the operating table the dressing is removed and the skin is painted with Surgical Dettol Metaphen, or liquor iodi mitis

In the past the iodine method of skin preparation was very popular, but people with fair skins can be very sensitive to the iodine and it has therefore largely been replaced by one of the other preparations

The place where the proposed incision is to be made is painted first and then by straight strokes on alternate sides the painted area is gradually enlarged until a large field is prepared Never come back to the centre from the periphery but always paint from the centre towards the periphery

Some form of premedication is commonly adopted to soothe the patient and render easier his entry into full anæsthesia

The subject of premedication is discussed in Chapter 13

nailbrush and soap or soap solution If possible, running water should be used but, failing this, the water must be frequently changed Each basin and the water used must be sterilized

In scrubbing the hands a definite routine should be adopted to ensure that each finger and each fingernail is separately scrubbed A useful method is to start at the inner side of each of the individual fingers (including the thumb) and then pass to the outer sides, these finished one takes in succession the tips of the fingers, the proximal and distal interphalangeal joints metacarpo phalangeal joints, and then finishes with the fronts and backs of the hands and arms

After this preliminary washing some antiseptic application is necessary such as Cetavlon or Zephiran

After this the hands are dried and covered with the sterilized rubber gloves

The efficiency of the hand scrubbing may be determined by covering the hands with lamp black in oil and attempting to wash it off Any part still black will reveal which areas are being inadequately scrubbed

The gowning and gloving of the surgeon and nurses are usually carried out in the operation theatre A gown is taken from a sterilized drum and is held by its top It is put on and buttoned down the back by a surgically clean nurse Care must be taken to avoid contact of the gown with any theatre furniture, etc, and *the outside of the gown should not be touched with the hand even after scrubbing up* An even more most important point is that *the outside of the glove should never be touched with the naked hand* which though carefully prepared must be considered capable of infecting the glove The glove with the cuff turned down is held widely open and with practice it is then easy for the surgeon or nurse to pass his or her hand right down to the finger tips (See Figs 50 to 54)

After putting on both gloves a sterile gauze swab may be taken and each finger smoothed down until accurate apposition of the glove is obtained

Preparation of the Patient The patient should be confined to bed for twenty four hours before operation to accustom him to his surroundings and in order that the general and local pre operative treatment may be carried out During this time the patient should practice using the urinal in bed

If possible the teeth should be scaled and cleaned by the dentist before the patient is admitted to hospital If the patient is not in the habit of using a tooth brush one should be provided In addition to cleaning the teeth an antiseptic mouth wash should be used

By this means the incidence of post operative chest complications and of secondary parotitis will be reduced

Owing to the risk of their causing post operative distension powerful purgatives prior to operation should be avoided

CLEANSING AND CARE OF INSTRUMENTS

Surgical instruments must be kept clean, dry, and in perfect working order

All instruments used at an operation should be immediately cleansed by being thoroughly scrubbed with a nailbrush and soap under a stream of cold water, when special attention must be paid to the teeth and joints of forceps After this they are boiled for ten minutes in 2 per cent sodium carbonate solution carefully dried and then replaced in the instrument case

This cabinet should not be situated in any room in which water is boiled or steam generated

In certain clinics the instruments are dipped in ½ per cent solution of liquid paraffin in benzine before being placed in the instrument case The benzine evaporates and leaves a thin film of paraffin on the surface All jointed instruments should have a drop of 3 in 1' oil or liquid paraffin placed on the lock or joint

The old type of scalpel with a fixed blade should not be used a second time, but sent to be resharpened

Hollow instruments such as trocars catheters etc, are cleansed first by running cold water through them, then they are boiled and dried, and finally methylated spirit is syringed through them

A drop of liquid paraffin is allowed to flow through hypodermic and other needles before replacing the stylet (wire)

All syringes should be taken apart immediately after use and throroughly washed, cleaned, sterilized and dried

If an instrument becomes infected during an operation and its immediate use is indispensable it must be washed under the tap and then boiled for at least five minutes in 2 per cent sodium carbonate before being again handed to the surgeon

Instruments may be polished with a paste of methylated spirit and Bon Ami using a piece of soft cloth or a chamois skin, but scrupulous care must be taken to remove all the powder from the teeth and joints of the various forceps with a brush

Rust stains can usually be removed with a piece of flannel and emery powder In other cases the instruments should be placed overnight in a saturated solution of stannous chloride which causes the rust to disappear by reduction

CLEANSING AND CARE OF RUBBER GLOVES

After operation surgical gloves should be cleansed by being thoroughly washed both inside and out with water and soap The gloves wrapped up in a piece of muslin are then boiled for five minutes before being hung up on a glove tree until both internal and external surfaces are perfectly dry Both surfaces are then well powdered with talc after which the gloves are tied up in pairs in packages marked with the size and condition of the glove

Before entering the operating theatre the patient should void urine and have all dentures removed unless otherwise ordered

During the course of an operation it is most important to maintain the body warmth, and this especially so in the case of children and feeble individuals The patient should be warmly clad and have the legs covered with long stockings

In cold weather the operating table should be warmed by hot water bottles or hot water containers which are slipped in under the top of the table If it is ever necessary to operate on an infant in a cold theatre it should be wrapped in gamgee tissue or in cotton wool

Preparation of the Surgical Instruments and Utensils All instruments brought directly or indirectly into contact with an operation wound must be sterilized

Dry heat is the ideal method for instruments composed of steel or glass the alternative in most cases however, is boiling immediately before use

The instruments are placed on a piece of lint in the tray of a sterilizer and boiled for ten minutes in 2 per cent sodium carbonate solution The addition of sodium carbonate not only prevents rusting of the instruments but adds enormously to the lethal power of the boiling water Boiling for at least five minutes in a 2 per cent sodium carbonate solution is lethal to all types of bacteria including spores

The instruments are then removed singly by sterile sterilizer forceps or collectively in the sterilizer tray and placed ready for use on a dry sterilized towel or in 1 in 40 phenol or sterilized sodium carbonate solution

The widespread belief that boiling blunts the edges of surgical knives has little foundation Scalpels should however, be protected from damage by contact with other instruments during boiling either by the use of a separate rack or by wrapping them in gauze

In some clinics knives are boiled in liquid paraffin with the object of preserving their edge and temper whilst in others all sharp cutting instruments, *e g* knives scissors needles etc are immersed either in pure phenol or liquor cresol saponatus for half an hour before use

Bowls and basins are boiled in a large bowl sterilizer In an emergency they may be flamed by swilling with methylated spirit which is then set alight

Nailbrushes are boiled for half an hour and then transferred by means of sterilized forceps to the wash basins Sufficient nailbrushes should be provided so that there is a separate one for each person

Nailbrushes may be bleached by soaking overnight in a saturated solution of oxalic acid

Glass instruments, such as syringes frequently crack if put directly into boiling water and should be placed in warm water and then boiled

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Holes in gloves are located by distending the glove with air and holding it close to the face or under water When a hole is present the glove is turned inside out, and a test tube is inserted into the finger so as to stretch the perforation

The glove around the opening after being cleansed with benzine and roughened by sandpaper is patched on its inner surface by means of rubber solution and a piece of unperished rubber cut to the required size from an old glove

THE CARE AND STERILIZATION OF CYSTOSCOPES

To secure adequate sterilization the cystoscope should be separated into its four component parts The telescope or optical portion is withdrawn and the compression screw, which tightens the washer

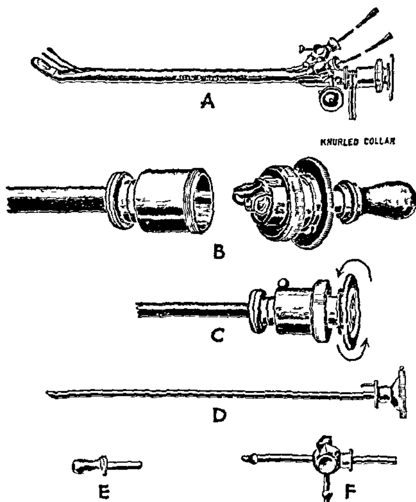


FIG 56 *A* Cystoscope *B* Valve screw with valve and valve collar *C* compression screw *D* Telescope or optical portion *E* Faucet *F* Flushing attachment

against the telescope, removed The valve screw with the contained valve and valve collar is then separated from the cystoscopic sheath Sterilization is completed by submerging the four separate units in 75 per cent alcohol 0 1 per cent oxycyanide of mercury, 2 per cent liquor cresolis saponatus or 2 per cent liquor formaldehydi for fifteen minutes and rinsing in sterile water

The two screws, the valve, the faucet and the two way flushing attachment may be sterilized by boiling but, in some cystoscopes the remaining portions, together with the electrical circuit, are incapable of standing heat as the cement fixing the lens and prisms would be injured and the insulation of the wiring destroyed

The entire instrument can also be sterilized by subjecting it to warm formaldehyde vapour in a special cabinet at a temperature of 115° Fahr to 125° Fahr for half an hour or by suspending the sheath and telescope in an upright glass stoppered bottle or cover jar containing three or four paraform tablets for a couple of days After use the instrument must again be taken to pieces for cleaning The four separated portions should be thoroughly cleansed by rubbing with a piece of lint under a stream of cold water, particular attention being paid to flushing the interior of the sheath and then each is thoroughly dried with a soft towel The barrel of the sheath is dried by wrapping a pledget of cotton wool round the roughened end of the wool holder provided for the purpose and passing it down the lumen Finally,

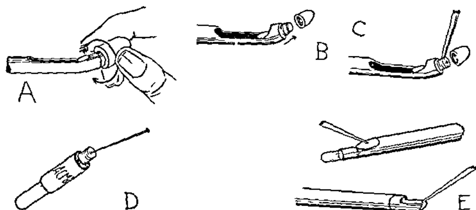


FIG 57 Details of the care of a cystoscope

A To remove the globe its cap is first unscrewed by holding it with a rubber tip Forceps should not be used for this purpose as they are certain to damage the instrument *B* After removal of this cap the globe may be lifted out but before it is replaced the contact surfaces on its base on the base of the lens cap and the tubular contacts around the globe should be gently cleaned and polished *C* A very small amount of lamp wax may be applied to the threads on the globe but this wax or any other greasy substance must be kept away from the contact surfaces *D* If the globe has a spiral wire contact on its base this should be lifted slightly with the point of a pin and cleaned before the globe is replaced *E* A wooden tooth pick may be used to clean the surface of the lens

Holes in gloves are located by distending the glove with air and holding it close to the face or under water When a hole is present, the glove is turned inside out, and a test tube is inserted into the finger so as to stretch the perforation

The glove around the opening after being cleansed with benzine and roughened by sandpaper is patched on its inner surface by means of rubber solution and a piece of unperished rubber cut to the required size from an old glove

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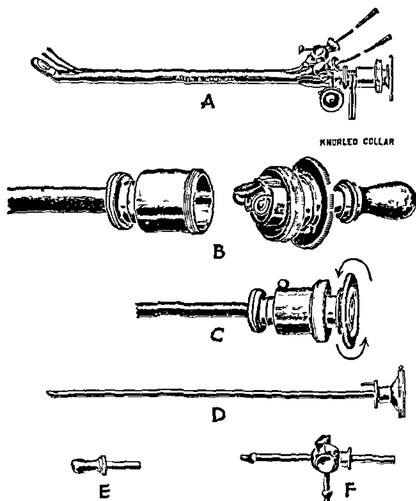


Fig 56 *A* Cystoscope *B* Valve screw with valve and valve collar *C* compression screw *D* Telescope or optical portion *E* Faucet *F* Flushing attachment

both the graduated tube and the glass window to each of which it is attached by bayonet joints The tube and the obturator may be sterilized by boiling but the light carrier and window require to be immersed for ten minutes in 2 per cent liquor cresolis saponatus after which they are rinsed in methylated spirit before being dried with gauze or a soft sterile towel

After use the light carrier is removed and the graduated tube and obturator are washed with soap and water before placing them in the sterilizer for five minutes On removal, both parts are thoroughly dried with a soft towel the barrel of the tube being dried with a pledget of cotton wool on long forceps Before the tube and obturator are placed in their case they are mopped over with a ½ per cent solution of liquid paraffin in benzine

the barrel is filled with methylated spirit for a few seconds and each part mopped over with a swab soaked in either methylated spirit or ½ per cent solution of liquid paraffin in benzine Before reassembling the instrument the valve is checked to see if it is working efficiently and not being held open by a particle of grit

Ureteral catheters may be sterilized by syringing through them 0 1 per cent oxycyanide of mercury, 2 per cent liquor cresolis saponatus or 2 per cent liquor formaldehydi and placing them in one of these solutions for fifteen minutes after which they are again flushed out and rinsed in sterile water Formaldehyde sterilization is, however, preferable and may be carried out in special ovens or sterilizers For private practice one may use a glass tube of sufficient length to take the catheter The ends of the glass tube are closed by stoppers into which are inserted perforated receptacles for carrying paraform tablets (Fig 41) Prior to placing a catheter in such a sterilizer it must be thoroughly dried both inside and out as otherwise formaldehyde acts on and destroys the shellac

THE CARE AND STERILIZATION OF SIGMOIDOSCOPES

To secure adequate sterilization the light carrier the electrical connexions and the rod with the lamp attached, are separated from

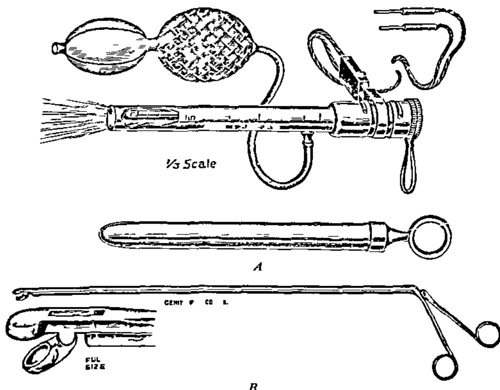


Fig 58 *A* Sigmoidoscope and obturator *B* Biopsy forceps for use with sigmoidoscope

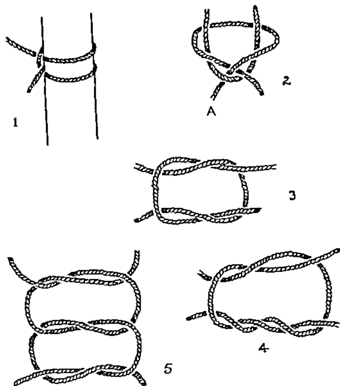


FIG 59 Knots used in surgery

1 Clove hitch 2 Single sheet bend (traction would be on end A) 3 Reef knot 4 Triple throw and 5 Surgeon s knot

Catgut Catgut is prepared from the submucous layer of the small intestine of the sheep and thus it is not possible to prevent contamination during its preparation It is sold in various thicknesses which are designated by the numbers —0000 000 00 0 1 2 3, and 4

CATGUT TABLE

PURPOSE	SIZE OF CATGUT	VARIETY OF CATGUT
Ligatures	0000 to 2	Plain
Peritoneum	0 to 1	Plain
Muscle	1 to 2	Plain or Chromic
Fascia	0 to 2	Plain or Chromic
Subcutaneous tissues	0000 to 00	Plain
Intestinal tract	00 to 0	Plain or Chromic

CHAPTER 9

LIGATURES, SUTURES, NEEDLES, LOTIONS, POWDERS AND DRAINS

LIGATURES AND SUTURES

LIGATURES are used to tie off blood vessels and sutures to stitch up wounds Many substances are in use for these purposes and they vary according to the structure to be stitched and to the preference of the surgeon These materials should be fine, strong pliable and easily handled cheap, non irritating to the tissues easily sterilized, and the knots must be reliable

The materials in common use include catgut, silk, cotton linen silkworm gut horsehair, nylon and stainless steel and tantalum wire

The function of suture material is to approximate the tissue edges so that they may unite Once union has occurred the suture is no longer of value, but till then which on the average is from ten to fourteen days, the strength of the suture line depends on the suture material The ideal material for deep sutures would therefore be one that retains its strength for at least fourteen days However, sutures and ligatures that are absorbed produce a reaction on the part of the tissues and the ideal suture material does not exist The non absorbable materials usually produce less reaction in the tissues, and their continued presence is believed by many surgeons to be no disadvantage Unless a portion of the skin has been removed there is little tendency for the skin edges to pull apart after a few days even so the deeper stitches should be placed so that the skin edges tend to lie together even before the skin sutures are inserted

When non absorbable deep sutures are used the sutures should be interrupted and the ends cut short If the knot is properly tied it will not unravel and thus for example the ends of cotton sutures may be cut half a millimetre long If a continuous non absorbable suture is used and the wound becomes infected, organisms and granulation tissue invade the suture material and provide too large a focus of infection for the defences of the body to deal with Thus a persistent discharging sinus may result On the other hand if the sutures are interrupted and short the defences of the body are more able to deal with each localized focus of infection

Little is gained by the use of material with a greater tensile strength than the tissues sutured and this fact is now influencing the choice of finer material

catgut first comes out of the tube it is inclined to be 'wiry' and buckle up soaking in warm Norm l saline counteracts this tendency

Since it may become contaminated it is inadvisable to use long lengths of catgut on spools, even if the catgut is drawn through the stopper of the bottle

Kangaroo Tendon This is prepared from the tendons of the tail of the kangaroo, or of the rock and scrub wallaby, and it is stored in 0 4 per cent biniodide or mercury solution in spirit, in a glass-stoppered jar

Kangaroo tendon is placed on the market in three different sizes, viz small medium and large It is now rarely used

Silk Silk is spun by the silkworm and is mainly protein in nature Although silk is classed as non absorbable there is no doubt that it is gradually absorbed over a period of months or years Silk has no natural twist, and thus it tends to unravel in the tissues It is obtainable in a twisted form which is used for fine sutures and in a braided form which was formerly used for ligating large pedicles Silk and other non absorbable materials are more difficult to handle until the surgeon becomes accustomed to them As silk and similar materials shrink while being boiled or autoclaved they should be wound on a piece of rubber tubing If wound round an inelastic bobbin and shrinkage cannot take place there will be a great loss in the tensile strength of the material

Waxed silk is sometimes used as suture material but it has the disadvantage that the knot, although easily tied also undoes easily

Floss silk is a specially prepared silk and is chiefly used surgically in large sizes It is advised by Maingot for the repair of herniæ because of the fibroblastic reaction which forms a firm posterior wall for the inguinal canal Immediately before use it should be soaked in a solution of penicillin (1 000 units per ml)

Cotton Cotton is prepared from fibres in the seed pods Each fibre has a natural twist so that it is easily woven into strands and it has little tendency to unravel It is mainly cellulose and is less likely than silk or linen to be invaded by granulation tissue and organisms Cotton also has the advantages that it is cheap is readily available and the knots remain firm Nos 24 and 40 are the sizes most often used

Linen Linen thread is woven from the fibres in flax leaves and it like silk has little natural twist in the fibres It also tends to absorb tissue fluids and is less suitable for use in the tissues than silk or cotton

Silkworm Gut Silkworm gut is the fibre removed from the body of the silkworm just as it is ready to spin its cocoon It is stiff smooth strong non absorbable material in appearance closely resembling spun glass There are five sizes varying from thick to extra fine

This classification is somewhat arbitrary, but a little practical acquaintance with the varieties renders it sufficiently accurate

Catgut will not stand ordinary boiling Its sterilization is always a matter requiring great care, and many different methods have been devised from time to time

The two essentials in the Sterilization of Catgut are —

THE REMOVAL OF FAT which affords some protection to the bacteria This is done by immersing the catgut in ether, boiling alcohol or other fat solvents This fat free catgut is on the market, put up in hanks and sold as raw catgut '

DESTRUCTION OF BACTERIA IN THE CATGUT BY DISINFECTANTS The methods in common use involve either the treatment of the sutures with iodine solutions (the method of Bulloch Lampitt and Bushill) or the sterilization of the sutures by heat while in anhydrous chemicals for example hydrocarbons of high boiling point The iodine method is used in many hospitals in England and Australia The heat sterilization technique is used in the commercial production of individually tubed sutures It is generally recognized that both methods when adequately controlled can be relied upon for the production of sterile sutures

It is essential that an adequate sample of each batch of prepared catgut is submitted to bacteriological examination

A greater loss of tensile strength occurs during the production of heat processed than of iodine treated catgut

Iodine Method This method was introduced in 1902 by Claudius who demonstrated that a 1 per cent aqueous solution of iodine and potassium iodide applied for at least eight days could sterilize catgut The suture is wound on to glass spools placed for nine days in the iodine solution then washed in 98 per cent alcohol containing 0 4 per cent mercuric biniodide the wash solution is changed on three successive days Then the sutures are placed in a storage fluid of 0 1 per cent iodine in 85 per cent alcohol or in 0 1 per cent iodine in toluol

Although storage in spirit yields a soft flexible ligature the catgut tends to be slippery this can be obviated by adding 2 per cent guaiacol to the storage solution

Heat Sterilization Method In this method the sutures are wound on fibre spools each suture is individually tubed all moisture is removed by drying in hot air oven and then the sutures are sterilized by heating to 158 to 159 C for one hour on two successive days in glycerine toluol paraffin or cumol

Several firms of surgical instrument makers supply sterile catgut in short lengths of glass tubing the outsides of which are sterilized before use by immersion in a fluid such as Zephiran, 1 in 100, for 20 minutes The tubes are then opened by breaking in a sterile towel When the

SURGICAL NEEDLES

The types of needles used varies with different surgeons and it is the nurse s duty to ascertain the individual peculiarities of each operator

As a general rule straight needles are used for surface work, whilst curved ones must be used in regions where the recovery of the point after its passage through the tissues would be difficult For descriptive purposes all surgical needles may be divided into three parts —the eye, the shaft and the point

EYE The eye of a surgical needle may be round square oval or pear shaped and it may pass either from side to side, or from before backwards A calix eyed needle is easy to thread but it is not uncommon for it to become unthreaded during the process of suturing

NEEDLE TABLE

Variety	Eye	Direction of Eye	Shaft	Point	Use
Surgeons suturing	Oval	Side to side	Round Straight or Curved	Triangular	All types of work except suturing intestines or viscera
Mayo s (catgut)	Square	Before backwards	Round (Flat at head) and Curved	Tapering	For all work except skin and intestine
Intestinal	Oval	Side to side	Round Straight or Curved	Tapering	Intestinal work
Cervix	Oval	Before backwards	Heavy Round Curved	Trocar	Suturing Cervix

A pear shaped eye enables the needle to be easily threaded and the thread then drawn into the narrow part of the eye which is in the butt It is thus securely gripped

In certain clinics needles with self threading eyes are used

Souttar s Eyeless or atraumatic needles are tubular with the catgut fixed in the butt of the needle The catgut thus completely fills the hole in the tissues through which the needle passes

SHAFT On cross section the shaft is triangular four sided or round and may be either straight or curved The latter may be —

(a) Quarter circle
(b) Three eighths of a circle
(c) Half circle
(d) Half curved *i e* curved towards point and
(e) Fish hook shaped

It is sterilized in small bundles by boiling for thirty minutes, and it may then be stored in 1 in 20 phenol solution The stiffness of silk worm gut is a disadvantage for the knots tend to undo and it is liable to break near the knot

Nylon Nylon is a synthetic resin which is non reacting in the tissues It is being more often used for suture material and is replacing silkworm gut but it has the disadvantage that unless it is braided it is difficult to tie a firm knot It is sterilized by boiling for thirty minutes

Horsehair Horsehair varies greatly in strength It may be con taminated with bacterial spores It is somewhat difficult to remove the grease with which each hair is coated, but this may be effected by washing well in liq cresolis saponatus with plenty of soap and it is then sterilized by boiling for thirty minutes It should be prepared as it is wanted as repeated boiling and prolonged immersion in phenol tends to make it brittle It was formerly used for suturing wounds on the face and neck where it is desirable to avoid permanent stitch marks, but these may be avoided with other suture material if the sutures are not tied tightly and if they are removed after forty eight to seventy two hours Horsehair is now less popular than formerly

Stainless Steel Stainless steel wire is a suture material that is used in very fine sizes such as No 36 gauge It has great tensile strength it is easily sterilized and it does not irritate the tissues but it is radio opaque and it is rather difficult to handle When tying the knots it is important to see that the wire is not kinked and it is the duty of the nurse assisting at the operation to prevent this After the knots are tied the ends are cut short and are turned inwards

Tantalum Tantalum wire is available as a single strand or in the braided form The latter is more easily handled It has recently been introduced for use when a non irritating and non absorbable suture material is required but it is expensive

Michel's Clips

Michel s clips may be used on the skin instead of sutures The wound edges are held together by apposition forceps and then the clips held in the jaws of special forceps are applied across the wound edges As with other sutures the edges of the wound must not overlap or healing will be delayed and also if the clips are tightly applied a permanent mark will be left at the site of each one Another pair of special forceps is required for the removal of the clips One jaw of these forceps is inserted under the clip and then as the forceps are shut the clip straightens out and it may be removed (Fig 90)

greatest value lies in the disinfection of instruments and apparatus which come into contact with wounds but they are also of use in cleaning the skin of the patient and the surgeon s hands

Phenol Lotion Phenol (carbolic acid) is cheap, readily obtainable, and, in strong solution, quite efficient It may be used undiluted as a caustic and since alcohol neutralizes the caustic effect this is frequently applied directly after the application of phenol, *e g* to an appendix stump

A solution of phenol 1 part alcohol 1 part and distilled water 20 parts may be used for washing the skin, carbolizing towels or disinfecting instruments but this is too strong for general use, and a lotion of half this strength is of wider value

Phenol is very poisonous, and not only is it deleterious if taken by the mouth but sufficient may be absorbed from a large phenol dressing to give rise to unpleasant symptoms such as headache, giddiness, nausea and vomiting The urine becomes an olive green colour which becomes darker on standing and in severer cases albuminuria and hæmaturia may also be present

Apart from being poisonous phenol irritates the skin and it may even produce gangrene when applied as a wet dressing

Alcohol Absolute alcohol has only a weak germicidal action but this is improved by dilution with water to a strength of 60 per cent (Surgical Spirit) Spirit is used for cleansing the skin and also as a storage fluid for sterile instruments etc It enhances the action of iodine a strong tincture of iodine *e g* 4 5 per cent in 70 per cent alcohol and containing 2 per cent potassium iodide to stabilize the iodine is one of the best skin disinfectants for patients who are not sensitive to iodine

Perchloride of Mercury Lotion Perchloride of mercury is widely used in strengths varying from 0 1 per cent to 0 01 per cent according to the circumstances It is cheap effective, inodorous and will keep indefinitely but it is very poisonous, and should not be left on raw surfaces or in cavities

For immediate use this mercury salt can be kept in concentrated solution say 1 in 1 000 which is diluted when required or as a tablet from which the manufacture of a lotion of given strength is purely a matter of calculation To avoid mistakes in identification the lotion or tablet has a little aniline blue added to give it a distinctive colour The use of perchloride of mercury is restricted by two actions viz, it tarnishes metal (*e g* metal instruments basins or syringes) and, further it is at once rendered non antiseptic by the addition of a quantity of blood or pus for albuminate of mercury is formed which resembles a fine curd

Corrosive sublimate (the name commonly given to perchloride of

POINT The point may be
- (a) Triangular in shape or lance pointed
- (b) Sharp cutting edge (Hagedorn needle),
- (c) Tapering
- (d) Trocar, or
- (e) Rounded and blunt (Cullen s needles for suturing liver and kidney)

After use, needles should be washed, scoured with "Bon Ami", thoroughly dried and sharpened

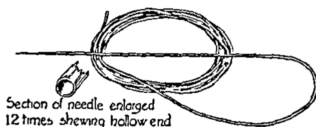


FIG 60A Souttar s atraumatic intestinal needle

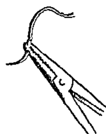


FIG 60B Showing a curved atraumatic needle with catgut suture *material being held in* the jaws of a needle holder
The portion of the needle in which the catgut has been clamped should not be grasped by the needle holder as that will break the needle or loosen the catgut

LOTIONS

Normal Saline Solution *This is* made by dissolving 3x of chemically pure sodium chloride in a gallon of sterile distilled water It is used for washing clean wounds

Hypertonic Saline Solution (a solution usually consisting of 5 per cent sodium chloride)

Its utility is restricted to the period of separation of sloughing and unhealthy tissues When once a granulating surface is obtained its application not only causes great pain but the granulations become œdematous and unhealthy

Antiseptic Lotions

Chemical agents of sufficient strength to destroy bacteria have a deleterious effect on the tissues and are of doubtful utility Their

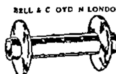




FIG 61 Dunhill s ligature holder and metal reel

Concentrated aqueous solutions are brown in colour but dilute ones are lemon yellow with green fluorescence Acriflavine has been found to be twenty times more powerful against *Staphylococcus aureus* than perchloride of mercury and 800 times more so than phenol

It differs from the above antiseptics in that its antibacterial property is not reduced, but actually augmented, by admixture with serum Further, this dye is one of the few antiseptics that inhibit bacteria in a concentration lower than that damaging to the tissues In fact, when acriflavine is used so as to control sepsis there need be no inhibition of healing Further at the strength of 0 1 per cent the solution is only very slightly acid, and is practically non irritating even to mucous surfaces

It possesses the disadvantage that it is fixed by cotton This must be allowed for when applying wet dressings, otherwise the nurse may be merely treating the wound with dyed cotton instead of an anti septic solution

To remove acriflavine stains from the hands rub with very dilute hydrochloric acid and then wash with water

Proflavine Recently acriflavine has been largely replaced by its precursor proflavine, a cheaper and less toxic dye

Unfortunately proflavine sulphate has a coagulating effect on wound surfaces frequently giving rise to a fibrinous yellow membrane

This defect has been largely offset by buffering the antiseptic with one quarter of its weight of sodium bicarbonate

As with all local antiseptics removal of slough debris pus etc is necessary for access, hence as a preliminary the wound should be cleansed with Normal saline and then dressed with a tampon saturated with proflavine solution in a strength of 1 in 1 000 This is then renewed as required

Monacrin or Acramine (5 amino acridine hydrochloride) in dilutions of 1 in 1,000 is a non irritant antiseptic with an anti bacterial activity similar to that of the other flavines against the common pyogenic organisms It does not stain the skin and is easily removed by water from fabric

Dettol Dettol is a clear yellowish fluid which is a powerful disinfectant and which forms a fine emulsion with water It may be used in the strength of 5 per cent in surgical spirit for disinfecting instruments and sterility may be expected in five minutes For the storage of instruments in a sterile condition a 2 per cent solution in spirit is effective As Dettol is relatively non irritating to the tissues it may be used for sterilizing the skin *e g* as a 30 per cent solution in spirit or it may be used undiluted and then swabbed off with spirit If it is used undiluted and is not washed off the skin is left in a slippery condition Dettol is also used as a 2 per cent aqueous solution for irrigating wounds and as a ½ per cent solution for vaginal douches

mercury) is a deadly poison if taken by the mouth, and may also produce symptoms of poisoning when absorbed from a wound or cavity The patient suffers from severe diarrhœa, which may become bloodstained and may lead to severe collapse Later the gums and tongue become inflamed and swollen there is a copious flow of saliva (ptyalism), the teeth may become loose and the breath heavy and offensive

The salts of mercury are very irritating to the the skin and may pro duce a local eczematous condition or even pustulation

Biniodide of Mercury Mercuric iodide is less irritating than the perchloride and in 1 in 5,000 solution is as effective in destroying bacteria as perchloride of mercury in 1 in 1,000 solution

It has the great advantage of neither coagulating albumin nor corroding metal instruments For immediate use it may be kept *either in concentrated solution, say 1 in 500 or as a compressed tablet*

Boric Acid Boric lotion is a saturated solution of boric acid crystals in water (4 per cent solution) and although it has only feeble antiseptic properties it has the advantage of being non irritating In rare cases it has produced symptoms of poisoning for example, when it was used formerly for washing out the bowel after appendicostomy, and nausea, loss of appetite vomiting diarrhœa and certain skin eruptions have resulted

Hydrogen Peroxide Hydrogen peroxide consists of water with an additional atom of oxygen to the molecule and it owes its bactericidal qualities to its oxidizing properties It is stored as a concentrated solution of a strength of 100 volumes, *i e* a strength which yields a volume of oxygen 100 times that of the original solution It is more stable than the weaker solutions For use it is diluted to strengths of 10 to 15 volumes and it is then of value as a bath for deodorizing and disinfecting septic wounds When brought in contact with wounds effervescence takes place owing to the liberation of oxygen, and it is rapidly inactivated It is thus not suitable for application as a wet dressing

Its efficacy is destroyed by heat and also by loose stoppering of the bottle in which it is kept

Acriflavine Acriflavine an aniline dye has been extensively used in strengths of 1 in 5 000 to 1 in 1 000 in Normal saline for wounds soon after infliction in order to prevent sepsis This reddish brown crystalline powder is soluble in 1 in 5 parts of water but is insoluble in fixed oils and in liquid or soft paraffin When a solution in oil is required oleated acriflavine (A P F) should be used

Aqueous solutions are perfectly stable up to 130° C hence they may be sterilized by heat if required They should however, be stored in amber coloured bottles as under the influence of light a deposit is gradually formed

instruments After cleansing surgical instruments may be stored in a sterile condition in a 1 per cent solution of Cetavlon, but it is necessary to add 4 grammes of sodium nitrite per litre of solution in order to prevent rusting

Cetavlon powder is available in envelopes containing 5 7 grammes and in larger containers If the contents of one envelope are dissolved in a pint of sterilized water, a 1 per cent solution is obtained

Merthiolate Merthiolate (sodium ethyl mercuri thiosalicylate) is usually supplied in a 1/1 000 dilution either as an aqueous solution or as a tincture (an alcohol acetone aqueous solution) The latter has a harmless colouring agent added

For the pre operative preparation of the skin the application of the tincture of Merthiolate should be preceded by a thorough cleansing with soap and water and by the removal of fat from the surface epithelium by alcohol and ether

A 1/5 000 to 1/10 000 aqueous solution of Merthiolate may be used for bladder irrigations but a twenty four to forty eight hour period should elapse after the use of previous antiseptics before instilling Merthiolate as it is incompatible with many of them

Merthiolate may be used as a 1/5 000 aqueous solution in the eye for pre operative preparation or for the treatment of infections but it should not be used with boracic acid or with silver preparations

The 1/1 000 aqueous solution of Merthiolate may be used to sterilize instruments but it has certain disadvantages such as causing dis colorization of rubber and rusting

Metaphen Metaphen (nitro anhydro hydroxy mercury orthocresol) is a non irritating antiseptic that is supplied as a 1/2 500 aqueous solution or as a 1/200 tincture

The tincture of Metaphen is a tinted 1/200 alcohol acetone aqueous solution and is used for skin disinfection It is applied after the skin has been cleansed with soap and water and the fat removed with ether and spirit The tincture leaves a slight yellowish stain on the skin and on linen but this is easily removed by washing with soap and water The tincture may also be used for the sterilization of mucous membranes such as that of the mouth

The aqueous solution of 1/2 500 Metaphen is used in the eye both pre operatively and for the treatment of infections

Metaphen does not corrode or tarnish metals (excepting aluminium) and it does not affect rubber goods It may therefore be used for the sterilization of instruments which should be left in the solution for at least ten minutes

Wounds may be irrigated with the 1/2 500 aqueous solution of Metaphen as it causes no pain and does not irritate the tissues

Hypochlorous Acid Hypochlorous acid in the form of eusol and Dakin s solution, is a cheap efficient and safe antiseptic Whilst

Zephiran (a mixture of alkyl dimethyl benzyl ammonium chlorides) is non poisonous, non irritating and almost odourless (unless an aromatic compound has been added to it for the purposes of recogni tion) It is a clear antiseptic fluid which readily dissolves in water, and is supplied as a 10 per cent aqueous solution called Zephiran Concentrate but it is used in a more dilute form

Zephiran is one of the antiseptics which lower the surface tension and which are thus able to penetrate more readily into the crevices of the skin Because of this Zephiran helps to remove the dirt and fat from the skin It is especially of value for the pre operative preparation of the skin but as Zephiran is inactive in the presence of soap this should be rinsed from the tissues before the antiseptic is applied

For pre operative preparation the skin is thoroughly cleansed with soap and water, shaved washed with tap water and dried in the ward —if possible more than twelve hours prior to the operation In the operating theatre the skin is scrubbed with three changes of a 1/1 000 aqueous solution of Zephiran alternating with three changes of 70 per cent alcohol

Dilutions of 1/3 000 to 1/10 000 may be used in the eye as a pre operative measure or for the treatment of infections For vaginal douches Zephiran is used in a dilution of 1/2,000 As a lotion for irrigating wounds 1/1 000 to 1/10 000 aqueous solution may be used for it is non irritating and does not delay healing

A 1/100 aqueous solution of Zephiran is efficacious for sterilizing instruments and takes from five to twenty minutes For the storage of sterile instruments a 1/2 000 aqueous solution of Zephiran is sufficient but an anti rust powder (sodium nitrite) must be added to prevent corrosion of metal instruments

Cetavlon Cetavlon or CTAB (cetyl trimethyl ammonium bromide) is a white odourless powder which is readily soluble in water It is a very effective antiseptic Like Zephiran it lowers the surface *tension and it is inactivated in the presence of soap*

Cetavlon precipitates serum proteins and destroys the leucocytes with which it comes in contact It is therefore not advisable as an application to wounds but it is very effective for the pre-operative sterilization of the skin and for the cleansing of burns of the skin For these two purposes it is usually used as a 1 per cent solution but it may also be used in an ointment containing sulphanilamide for application to burns (*e g* the No 9 Cream recommended by the Medical Research Council Report on Burns and Scalds)

To increase the potency of Cetavlon against certain organisms 0 1 per cent Hibitane may be added

Cetavlon is also effective for the cleansing of contaminated bowls baths and other hospital fittings and for the disinfectio of surgical

which he named penicillin, was present in filtrates of broth culture of the mould and demonstrated that its action was remarkably selective and limited to certain sensitive bacteria including *Streptococcus pyogenes*, *Pneumococcus*, *Gonococcus*, *Meningococcus*, *Staphylococcus aureus* the gas gangrene group *Bacillus anthracis* and several others It had no action in dysentery, cholera, tuberculosis or plague

In 1940, Florey and associates at Oxford University first demonstrated the lack of toxicity of penicillin in laboratory animals and reported its successful use in a series of human infections

Penicillin is an unstable acid and the preparations used in therapeutics are its salts their action is bacteriostatic rather than bactericidal

Furthermore unlike the sulphonamides and most other antiseptics the activity of this substance is maintained with scarcely any diminution in the presence of serum

The sodium salt used for systemic treatment is hygroscopic and somewhat less stable than the more easily handled calcium salt which is used mainly for local application

Penicillin may be given by mouth as lozenges to suck but most of its preparations are destroyed by the acid of the stomach, its absorption is rapid from muscle from subcutaneous tissue and from the small intestine

An adequate blood level can be maintained by the administration of penicillin in a continuous 5 per cent dextrose or Normal saline intravenous infusion by the drip method or by intermittent intramuscular injection

The adult dose varies from 15,000 to 500 000 Florey or Oxford units every three to six hours both day and night and this may be continued for seven days or even longer It is the length of time over which adequate doses of penicillin are given that is more important than the total amount injected

Different preparations which have been used for local application are —

(1) A dry calcium penicillin powder

(2) A powder in which calcium penicillin is diluted with sulphanilamide to give a strength of up to 5 000 units per gramme

(3) A solution in distilled water containing 250 units of calcium penicillin per ml

(4) A cream made up of lanette wax soft paraffin and water containing 500 units of penicillin per ml

Investigations to date have shown the value of penicillin in —

(1) Prevention of infection in wounds enabling many soiled or contaminated wounds to be treated in much the same way as non infected wounds

(2) Promotion of healing of burns and in ensuring the success of skin grafting

highly destructive to bacteria, it is non toxic and non irritating to the tissues, and unlike most antiseptics, it can be used in solutions sufficiently powerful to destroy virulent bacteria without, at the same time, damaging the tissues It is usually used in a 0 47 per cent solution, which should always be not more than five days old

Since light hastens its decomposition, it should be kept in dark bottles and stored in a cool place

Being a volatile substance hydrochlorous acid fails to act efficiently unless brought directly into contact with infected tissues, hence the tissues should be kept moist with the solution, either by frequently dressing them with gauze soaked in the fluid or by continuous irrigation

It has been extensively used for infected wounds with the satis factory results both in military and in civil practice It is slightly corrosive to fabrics and metal instruments and causes bleaching of coloured fabrics

ANTISEPTIC POWDERS

Boric Acid Powder Since boric acid does not irritate it is largely used as a dusting powder for wounds ulcers and moist skin surfaces, as well as for insufflations for such cavities as the ear, etc

A useful dusting powder is acid boric zinc oxide starch bismuth carbonate in equal parts

Iodoform Iodoform was formerly used in septic and tubercular affections but it has been almost completely replaced by penicillin and streptomycin

Sulphanilamide Sulphanilamide crystals may be sprinkled through out the wound in an amount sufficient to provide a heavy frosting The crystals may be sterilized by using dry heat obtained by means of a paraffin bath or electric oven to maintain the crystals at 150° C for one hour

Although the sulphonamide group is active against a wide variety of organisms they are inactivated by para amino benzoic acid which is so abundantly present in pus Hence their local application should be reserved for prophylactic use against pyogenic infection, *i e* before the products of tissue breakdown have time to accumulate

Proflavine Proflavine sulphate has been found to be a reliable antiseptic agent against most pyogenic micro organisms hence the powder is used as a local application for soiled or contaminated wounds An amount varying from 0 5 to 2 0 grammes may be sprinkled on to a wound or if necessary introduced into the depths by a blunt dissector

Penicillin In 1929 Fleming Professor of Bacteriology in the University of London observed that colonies of Penicillium notatum the green mould seen on mouldy bread inhibited the growth of bacteria in their vicinity Fleming showed that the inhibiting substance

RUBBER TISSUE Folded pieces of rubber dam or thin strips cut from discarded rubber gloves form excellent drainage materials for wounds with only moderate discharge They do not act by capillary attraction but simply provide an avenue of egress for discharges Their most useful field is that of drainage of uninfected wounds where there has been much trauma and some discharge of serum is likely

RUBBER TUBING The india rubber tube introduced by Chassaignac provides an open channel for the flow of discharges

These tubes may be used either plain or fenestrated, or the tube may be split lengthwise or spirally with a pair of scissors and a strip of gauze may be inserted down its lumen

The outer end should be maintained in position by suturing it to the margins of the wound and by transfixing it near the end with a sterilized safety pin Unless so fastened a drainage tube may slip into a long sinus and be temporarily lost

If there is any difficulty in removing the tube after the removal of its sutures it can usually be freed by traction and rotation

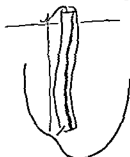


FIG 62 Banham s method of fixing a tube to the bottom of a cavity with a suture

The quality of the rubber used is important, as sterilization by heat is desirable and an inferior quality of rubber tends to disorganization when exposed to heat In ordering rubber tubing both the bore and the external diameter should be noted

When drainage is employed merely as a precautionary measure a piece of $\frac{1}{4} \times \frac{3}{8}$ inch tubing (No 12) will probably be used, and this is withdrawn in 48 hours

For regular drainage a $\frac{1}{2} \times \frac{3}{4}$ inch tube (No 20) will probably be used and should not be withdrawn for two days, that is until a definite track has formed

Dunhill s thin rubber tubing is about $\frac{1}{4}$ of an inch in diameter and is thinner than the rubber in gloves This is used by some surgeons for draining the wound after thyroidectomy

Instead of a single drainage tube, a small tube bent on itself and with a number of holes may be used

Usually the edges of the drainage hole come together after removal of the tube but, to ensure accurate closure of its lips the surgeon may at the time of the operation insert a stitch which is left long and which is tied upon removal of the drain

If the tube is draining into an abscess cavity it should be changed every second day at the outset and subsequently every day As the discharge lessens the tube can be diminished in length and calibre

The skin round a drainage tube is sometimes inverted so that the

(3) Infections (either acute or chronic) due to sensitive organisms, *e g* pneumonia gas gangrene and gonorrhœa

Because of their physical properties most preparations of penicillin, whether in ampoules, powders, or solutions, should be kept in a refrigerator or ice chest but some preparations, such as Penicillin Glaxo, retain their activity in unopened ampoules if stored in a cool place refrigeration being unnecessary

Penicillin must not be allowed to come in contact with antiseptics particularly those containing spirit Syringes needles rubber tubing etc should be boiled only in water of neutral reaction if they are to be used for the injection of penicillin and they should not be sterilized by antiseptics Sterilization by dry heat is preferable to boiling

DRAINAGE MATERIALS

Drainage of wounds becomes necessary under two conditions —

First, to provide a channel and means of escape for lymph blood, pus etc which would otherwise accumulate in some actual or potential space in the tissues

Second to provide a channel for the escape of the contents of hollow viscera, *e g* urinary or gall bladder etc when it is desired to effect the artificial emptying of these viscera

Varieties Gauze, rubber tissue and rubber tubing are the basis of practically all drains

GAUZE Gauze wicks act by capillary attraction the fluids pass along the fine capillary channels between the fibres and they may be effective in their action even though the direction of drainage is against the force of gravity

Gauze wicks however, have two great disadvantages —Firstly, lymph is apt to coagulate in the meshes of the gauze and the wick then acts as a plug secondly granulations from the drainage channel grow into the interstices of the gauze, so that its removal may be both difficult and painful

Cigarette drains which consist of a strip of gauze about which a piece of rubber dam has been wrapped overcomes the latter objection

After the removal of a gauze wick or rubber drain a track is left along which fluid may subsequently make its way to the surface, and this feature is the chief virtue of gauze wicks

If a wound has been plugged with gauze the least painful method of removing the plug is to keep the wound wet by dropping on it peroxide of hydrogen from a syringe and then withdrawing the gauze, piece by piece In this manner with time and patience one can usually remove the plug from a large wound without an anæsthetic and without causing much pain

Gauze that has been smeared or soaked in paraffin either soft or liquid, does not tend to adhere to granulating surfaces and thereby the pain caused by its removal can be greatly reduced

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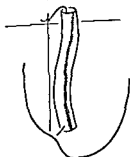


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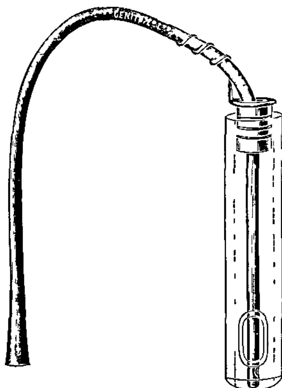


FIG 63 Arrangement of catheter inside larger tube to act as a sump drain

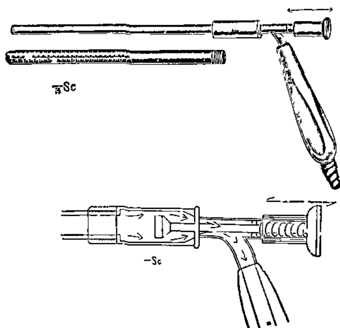


FIG 64 Simpson Smith s sucker with spring piston to open and shut the circuit

The larger perforated metal tube forms a sump and suction is applied to the smaller inner tube

tube lies against a broad surface of skin instead of against the raw edges This reduces excoriation and ulceration around the tube

Banham s method by which the inner end of a drainage tube is fastened to the tissue close to the point at which drainage is to be expected (Fig 62) is particularly useful and has the added advantage that, at any time without waiting for the absorption of any deep fixation suture the tube may be readily removed by cutting the thread lying outside the tube

Special Drains SELF RETAINING DRAIN A Foley catheter with an inflatable cuff provides a good self retaining drain in many positions

SUMP DRAINAGE This is of value in situations such as the peritoneal cavity where the openings in the drain tube frequently block with omentum etc if suction is applied directly With a sump drain suction is applied to the inner tube and the fluid which has passed into the bottom of the large tube is removed

DRAINAGE TUBES FOR EMPYEMA THORACIS These are considered in Chapter 22

SUPRAPUBIC BLADDER DRAIN A White s or a de Pezzer s catheter is usually used, but if these are not available a two tube drain will often be adequate A No 6 rubber catheter is stitched to the side of a large rubber drainage tube of about one inch diameter and four inches long and having two large openings on the side near the inner end

A long piece of Paul s colotomy tubing (or the inner tubing of an old bicycle tyre) leading to a receptacle under the bed is attached to the outer end of the larger tube by a right angled glass junction

An irrigator is connected to the catheter, and the solution, after washing out the bladder flows out through the tubing into the receptacle underneath the bed

SYRINGES

Four main types of fittings between syringes and needles are used These are the Record the Luer Lok the Labat and the bayonet mounting (Fig 29)

CHAPTER 10

THE OPERATING THEATRE

Structure POSITION In a hospital the operating theatre should be well removed from the wards except the resuscitation ward It should have a separate wing allotted to it or it should occupy the whole of the top of a small wing The theatre itself should be large well ventilated, and be lighted by an auxiliary plant in addition to the usual supply from the power house

THE SHAPE OF THE THEATRE The theatre should be square or oblong and a liberal amount of space should be provided The angles between the floor and the walls between the walls themselves and between the walls and ceiling should be rounded to permit ready cleaning this arrangement prevents collections of dust and foreign particles

The entire interior of the theatre is usually white to facilitate the detection of dust and to aid illumination

Glass shelves wash basins sinks etc should be in a room off the theatre and should stand out from the wall so that they can be thoroughly cleaned at the back

THE FLOOR The floor must be of some homogeneous material which has a smooth surface will wash and will not absorb foreign substances such as pus blood and secretions

A broad gutter is built along the length of each wall The floor slopes towards these gutters which in turn fall towards one point and thus the floor can be flushed down with cleansing fluids which will quickly drain away

THE WALLS The walls should be covered with some material which is smooth and polished *e g* well laid white tiles with their joints covered with some form of soluble glass

Some modern operating theatres are finished in battleship grey which background is thought to afford the best perception of the details of the wound

THE DOORS should be sliding rather than hinged as they cause less disturbance of the air when moved

THE CEILING Steel washable ceilings are now popular they should be flat rather than dome shaped as they are then less resonant They should be painted with enamel paint which is easily renewed and washable

Lighting Many operating theatres are furnished with plate glass

windows on the whole of one aspect but more recently a few have been built without windows

Over the operating table it is advisable to have a light, with at least a one hundred candle power globe, the light from which is reflected by a number of mirrors placed around it in the form of a circle so that no shadow is cast

When the above type of illumination is unavailable instead of a powerful centre cluster it is preferable to have five or more separate lights with reflectors over the operating table like the lights over a billiard table The lights must be placed sufficiently high over the table to prevent contact with them

The theatre light should be kept dusted so that there is no possibility of shaking down dust (and organisms) when the light is adjusted

A number of electric lamps and plugs are also placed where needed about the room

Ventilation The air of the operating theatre must be made as pure as possible, especially in large towns where the amount of dust in the air is considerable and here the plenum system of ventilation is advisable The air is taken from more than 10 feet above ground level, and forced by an electric fan into the basement where it passes through electrostatic filters to remove the dust and organisms It then passes through moist jute or hemp material or through a screen of water formed by a special tap and thereby loses any remaining dust and takes up moisture

The purified air is forced over hot pipes to warm it, if need be and then passes through four or more flues which enter the walls of the operating theatre near the floor

The temperature of the operating theatre is usually controlled automatically with a thermostat and is kept at about 70° Fahr

The flow of air into the theatre should be sufficient to produce an outflow of air through the doors which will prevent unclean air entering the theatre when a door is opened This should be tested occasionally by smoking tapers held near the open doors

Heating Apparatus Any additional warmth that may be required for the operating theatre is obtained by the use of steam or electric radiators which should be fixed to the wall by hinges so that they can be moved for cleaning If electric the elements must be completely concealed

The Fixtures The fixed fittings in the operating theatre must be as few as possible Nowadays the tendency is to house all wash basins sinks etc in an adjoining room opening directly off the operating theatre

THE BASINS may be placed along the wall where the floor is lowest, and they empty into the gutter They should be three or four in number and of large oval shape for the easy immersion of

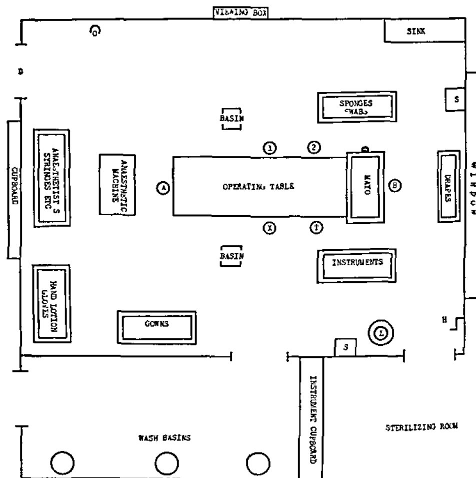


FIG 65 Diagram of one of the four operating theatres at The St George Hospital Kogarah N S W showing the very satisfactory arrangement of the theatre personnel and equipment

A Anæsthetist *B* Bucket *D* Door to the anæsthetic room *H* Handle for the metal roller blind *L* Sterile lifters in a sterile container on a small table *O* Oxygen *S* Sucker *T* Instrument sister *X* Surgeon 1 Surgical assistant and 2 Nurse who is in charge of sponges and swabs Mayo indicates a Mayo instrument table In addition there is a nurse who acts as a scout The overhead light and the mobile spot light are not shown in this diagram The cupboard on the left hand wall is for the storage of catgut and other sutures and has sliding doors The eight items indicated by double lines are mobile tables The lotion stand is not shown in this diagram

the arms and forearms of operators The water outlet should be arranged as a gooseneck in the form of a stream or shower or both, which permits the lavage of the arms and forearms with running water The taps must be controllable by the elbows feet or knees

On a glass shelf above each basin are placed jars containing a blunt nail cleaner a sterilized nailbrush and a bowl containing an antiseptic solution for the hands *e g* Zephiran 1 in 1 000

A LARGE PORCELAIN SINK is needed in the sterilizing room in which the instruments, bowls etc can be washed

A TAP with a good supply of water should be provided with a detachable hose for thoroughly flushing the floor and gutter

Operating Theatre Furniture All the furniture is made of enamelled iron metal or plate glass so that it can be easily and thoroughly cleansed The articles required are an operating table, instrument and dressing table, (it is advantageous for these to have an upper and lower shelf) an anæsthetist s table tables for gloves and gowns a table to hold the container for the sterile lifters two or more basin stands, two operating stools, and a lotion stand with glass jars etc

If the rubber tyres on the wheels are not made of a conducting material each piece of furniture should have an earthing chain to dispel any static electricity

The instrument cupboard should be recessed into one wall and it should have sliding glass doors

A cylinder of oxygen (which is checked daily) is standing on its base or trolley near the anæsthetist s table

Fig 65 illustrates a convenient arrangement for the tables basins and assistants

THE OPERATING TABLE This is constructed of metal and the top is usually in three pieces which are adjustable to different positions the chief of which are —

The Horizontal Position

The Trendelenburg Position where the head and centre pieces are tilted so that the pelvis is raised above the head The patient lies on her back and the foot piece of the table is usually lowered so that the knees bend and the lower legs drop down A strap may then be applied at the level of the calves As a result some of the weight is taken on the legs and there is less weight on the shoulder supports

The fact that there is pressure on the back of the calves is a possible objection to taking some of the weight through the legs Such pressure may cause thrombosis of the veins of the calves Some surgeons consider this so likely and so important that they do not lower the end of the table when using the Trendelenburg position and indeed even when operating with the patient in the dorsal position they rest the ankles and heels on pads of rubber so that there will be no pressure on the calves This has much to recommend it

The Jack Knife Position with the patient lying face downwards with the buttocks at the bend in the table and the legs and thighs hanging down The buttocks are thus the highest part This position may be used for operations on the buttocks and anus

The Lithotomy Position in which the legs are flexed at right angles to the body and supported on sliding lithotomy stirrups which fit into grooves at the sides of the table The foot piece is lowered or removed

The Hartley Position for head operations in which the table slopes gradually downwards from the head to the foot

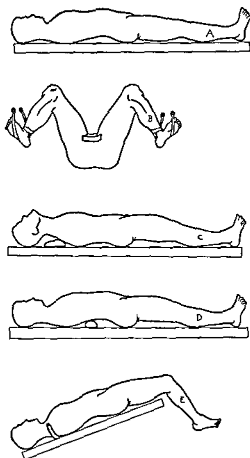


FIG 66 Positions of the patient often used in the operating theatre

A Dorsal or supine position *B* Lithotomy position *C* Thyroid position with a small sand bag under the shoulders and lower part of the neck *D* Gall bladder position with a small sand bag under the lower ribs or the gall bladder rest of the operating table raised and *E* Trendelenburg position

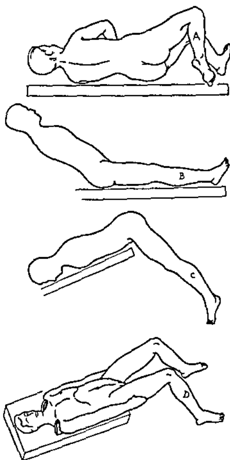


FIG 67 Positions less often used in the operating theatre

A Left lateral position *B* Fowler s position which is rarely used in the operating theatre but is more frequently used in the wards *C* Buie position which is sometimes used for operations on the rectum and anus and *D* Lithotomy Trendelenburg position which is used during a synchronous combined excision of the rectum

Rose s Position in which the head piece is lowered to prevent the flow of blood into the larynx during mouth and throat operations

Useful accessories for the table are —

Back Rest for use in gall bladder and kidney operations an alteration in the level of this bridge is effected by means of screws

Arm Rest which allows of operations on the partly extended arm

Trough, which is arranged to catch the drainage from the bottom of the table

Kocher s Goitre Screen which consists of a removable iron hoop which arches across the centre of the head piece and to which is fixed

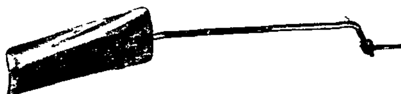


FIG 68 A simplified form of the Lloyd Davies stirrup for fixing the legs in the lithotomy Trendelenburg position

a sterile towel This screens the anæsthetist and the head of the patient from the operation area

To avoid undue pressure of the patient on its hard polished surface the table is covered by a mackintosh in which is placed a slab of sponge rubber A small mackintosh covered with a small sheet is also placed directly under the field of operation The table is then ready for the patient who is covered by two small sterilized blankets

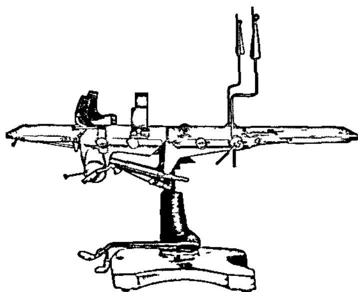


FIG 69 Operating table on platform base with lithotomy stirrups shoulder pieces and arm rests in position

leaving only the operation site uncovered This is then encircled with sterile drapes which are held in position with towel clips

All blankets entering the theatre should be completely surrounded by clean sheets fixed in position with safety pins The pillow is small and is covered with waterproof sheeting It is enclosed in a clean pillow case

THE INSTRUMENT TABLE This is covered with a sterile mackintosh and a sterile towel and on the towel is placed a tray containing the instruments A tray with knives, jars with catgut and suture materials is placed on the same table or on a second adjacent small table

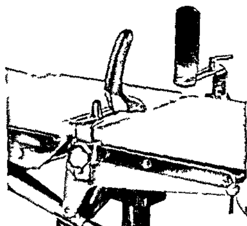


FIG 70 Pelvic rests with sponge rubber pads to hold the patient in the Trendelenburg position without the use of shoulder rests

A large bowl of sterile water should be placed on or near the instrument table so that instruments which become soiled with blood may be cleansed

ANÆSTHETIST S TABLE The requirements of the anæsthetist are discussed in detail in Chapter 12

THE DRESSING TABLE This table is covered with a sterile sheet and is intended to hold materials such as dressings swabs etc

The dressings are done up in sterile towels and should be placed unopened on the dressing table

The various packets should contain —Plain and ribbon gauze abdominal pads bandages towels and gauze squares

Two rolls of adhesive plaster of different widths strapping scissors and bandages should be readily available in the theatre

BASIN STANDS Basin stands must be placed within reach of the surgeon and his assistant during the operation The pattern should be such that it is possible to lift a bowl from the ring with sterile lifters

LOTION STAND The lotions stored in large glass jars are kept on the upper shelves of the lotion stand Each jar has the name and strength of its contents engraved on the front

On the lower shelves should be —

1 Sterilized drainage tubes and Paul s tubes of all sizes and shapes
2 Glass syringes funnels nozzles etc
3 Flasks of sterilized Normal saline solution
4 An apparatus for intravenous infusion which is kept ready sterilized

5 Sterilized test tubes and swab sticks in a metal rack, for bacteriological purposes
6 Sterilized safety pins

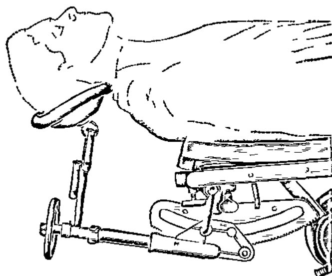


FIG 71A Universal headrest for bronchoscopy and œsophagoscopy
The raised position is used for examination of the upper œsophagus

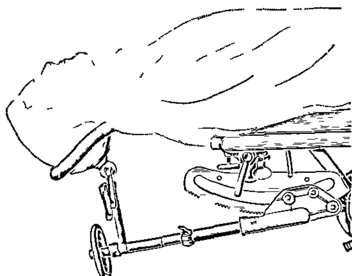


FIG 71B Universal headrest for bronchoscopy and œsophagoscopy
The low extended position is used for examination of the lower portion of the œsophagus

NOTE All glass jars for lotions ligature troughs bottles etc should have lids which fit over the top that is the mouth of the vessel should be ground on its outer side and fit into the cover which is ground on the inner side of its rim When such lids are being removed dust on them should not fall into the vessel

leaving only the operation site uncovered This is then encircled with sterile drapes which are held in position with towel clips

All blankets entering the theatre should be completely surrounded by clean sheets fixed in position with safety pins The pillow is small and is covered with waterproof sheeting It is enclosed in a clean pillow case

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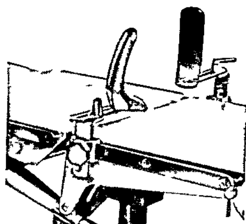


FIG 70 Pelvic rests with sponge rubber pads to hold the patient in the Trendelenburg position without the use of shoulder rests

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3 Flasks of sterilized Normal saline solution
4 An apparatus for intravenous infusion which is kept ready sterilized

THE ANÆSTHETIC ROOM This should open directly off the theatre and its walls and floor should be similar to those of the theatre The fixtures needed are simple, being a sucker a wash basin, an electric light over the patient and shutters for the windows, so that it can be used for ear nose and throat work, and other examinations The anæsthetic room is heated in the same way as the theatre and a useful adjunct is a 'blanket warmer, a cupboard containing hot pipes and perforated shelves in which blankets and mackintoshes are warmed and stored

It is desirable that the patient is placed in the position for the operation and that the sheets and mackintoshes are arranged before he is wheeled into the theatre

A STERILIZING ROOM This opens directly off the theatre and contains —

(i) *Utensil Sterilizer* A large sterilizer for basins bowls kidney dishes irrigators etc

(ii) *Instrument Sterilizer* Various forms of these are in use, but the simplest are electric and have a perforated tray on which the instruments are placed

(iii) *Syringe and Ligature Sterilizer* This is small and electric for sterilizing silkworm gut wire syringes needles cotton etc

A Water Sterilizer Absolutely sterile water is a necessity for operative technique but in addition it is advisable to have the water chemically and physically pure to prevent precipitation when chemicals are dissolved in it For the purpose of sterilizing water two kinds of apparatus are available, viz —

A *which sterilizes the water at boiling point i e* 212° *Fahr* Water boiled in a clean vessel for twenty minutes and used immediately is practically sterile, and may be used for minor and emergency surgery

B *which sterilizes water at a higher temperature than boiling point* and is the more effectual method

The objection to B is that the water is liable to be either too hot or too cold when about to be used To obviate this an apparatus may be used which consists of the following various parts and processes

(i) *A Berkefeld Pressure Filter* is connected with the hydrant water supply and has a two way outlet to supply two tanks The porous stone handle can be removed by unscrewing a heavy metal clamp at the top and must be frequently cleansed by lightly brushing it and then placing it in a vessel of cold or tepid water and boiling for one hour

(ii) The two outlets which are both regulated by valves lead to two tanks which they fill the height of the water in each tank being indicated by gauge glasses When the tanks are full the two valves are closed which cuts off the main water supply



FIG 72 With the male patient in the lithotomy position for rectal and anal operations it is necessary to hold the scrotum up out of the way and adhesive strapping fixed to the legs or to the abdomen may be used for this purpose

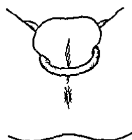


FIG 73 Instead of adhesive strapping a thick piece of rubber tubing may be used to hold up the scrotum

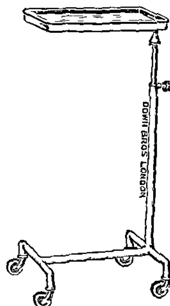


FIG 74 Mayo instrument table to push over the operating table The height of the tray may be altered as required

TWO OPERATING STOOLS One stool is required for the anæsthetist and the second is needed for the surgeon during certain operations *e g* hæmorrhoidectomy

A SOILED DRESSING BUCKET is placed under the operating table to receive the dressings removed from the patient etc

Accessory Rooms The theatre block should contain certain rooms communicating with the operating theatre some of which are indispensable, and others desirable These accessory rooms comprise —

Dry Heat Sterilization by dry heat *i e* without exposing the articles to moisture, may be carried out in a hot air oven Various powders, syringes and needles may be sterilized in this way

Room for High Pressure Steam Sterilizer The sterilization of dressings, gowns etc is usually carried out in a separate room near a supply of live steam The articles are placed in drums which are made of various sizes to fit inside the sterilizer

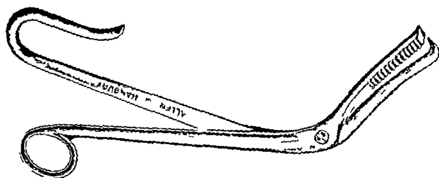


Fig 76 Cheatle s sterilizer forceps

The high pressure steam sterilizer (Autoclave) possesses great penetrating power, secures rapid disinfection and is a reliable method Steam, under a pressure of 15 lbs and acting for twenty minutes destroys everything having life, and assures complete and certain sterilization

However, the ever present difficulty is to ascertain the exact temperature reached in the centre of a packet or a drum of dressings in any given sterilizer This temperature must necessarily be very different from that of the superheated steam around the outer side of the container, the heat of which is indicated by a gauge projecting from the instrument

Nevertheless various indicators such as small oblong blocks of fusible metal (pyrometers) having melting points ranging from 203° Fahr (95° C) to 248° Fahr (120 C) may be buried in the centre of the dressings before sterilization and the effective temperature determined by examination when the dressings are unpacked

In the absence of a central steam supply the steam may be generated in the autoclave This type of sterilizer has an outer jacket which is half filled with water and boiled either by electricity or gas When the water boils the steam passes into the cylinder and then travels through the contents of the drum As the steam has no free outlet the pressure in the cylinder rises till it reaches 15 lbs when the safety valve blows off At the end of twenty minutes the gas or other heater, is turned off and *when the apparatus has cooled down* the lid is opened and the drums removed

(iii) *The two tanks are now heated* As the steam pressure safety valves at the top blow off at 15 lbs pressure, a boiling temperature of 250° Fahr is maintained, and the water must be kept at this temperature for twenty to thirty minutes after which the heating is turned off

(iv) *Cooling of sterilized water* The water in the tanks is now absolutely sterile but too hot for immediate use, so, to facilitate cooling cold water from the hydrant is run through the ' cooling coil " in one of the tanks (which is marked Cold ') by which means the temperature can be reduced in from ten

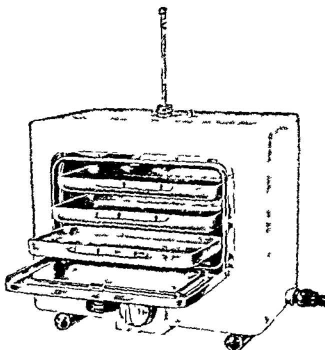


Fig 75 Electric hot air sterilizer

to twenty minutes The other tank (marked ' Hot ') has no cooling coil and its contents are allowed to cool down gradually and so by drawing water from both tanks sterile water of any desired temperature can be obtained The sterile water tanks are readily connected with the operating theatre if desired by piping the outlets through the partition which separates the sterilizing from the operating room

Over a gutter in the sterilizing room a marble slab is fixed so that it stands a few inches away from the wall This is used for scrubbing mackintoshes, the part cleansed being allowed to pass over the back of the slab This slab slopes down on one side towards a sink a shower tap is placed at the higher end so that the debris is easily carried away

THE SURGEON'S ANTE ROOM This should be near the theatre but not opening directly from it It should contain lockers, a shower and a toilet, and there should be towels, theatre clothes, canvas boots, and gowns, caps and masks for the anæsthetists Before entering the theatre everyone should change their street clothes for freshly laundered theatre clothes and canvas boots Those who will be scrubbing up obtain their sterile caps and masks at the door of the theatre



FIG 77 Sterilizing drum

For sterilizing the sliding band is moved so that the holes of the drum are uncovered in order that the steam will pass into the drum After the contents are sterilized the band is moved back to cover the holes

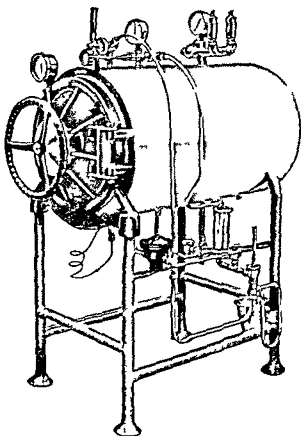


FIG 78 High pressure steam sterilizer for use with the main steam supply

THE SURGEON'S ANTE ROOM This should be near the theatre but not opening directly from it It should contain lockers, a shower, and a toilet, and there should be towels theatre clothes, canvas boots, and gowns, caps and masks for the anæsthetists Before entering the theatre everyone should change their street clothes for freshly laundered theatre clothes and canvas boots Those who will be scrubbing up obtain their sterile caps and masks at the door of the theatre

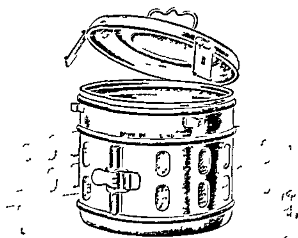


FIG 77 Sterilizing drum

For sterilizing the sliding band is moved so that the holes of the drum are uncovered in order that the steam will pass into the drum After the contents are sterilized the band is moved back to cover the holes

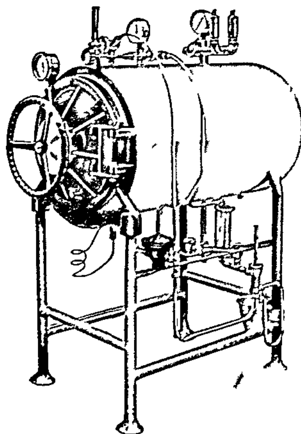


FIG 78 High pressure steam sterilizer for u *supply*

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rs (fine)
ting forceps (fine non toothed)
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ule
ng pen
l (No 3 handle with No 15 blades)
ls (No 4 handle with No 15 blades)
ooks (Gillies or Kilner s)
quito pressure forceps
(fine)
etractors (small)
holders (Gillies or Dunhill s)
s (fine curved cutting edged)

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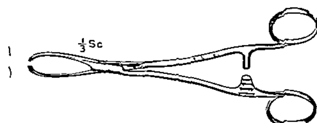


FIG 80 Moynihan s tissue forceps

CHAPTER 11

INSTRUMENTS REQUIRED FOR SURGICAL OPERATIONS

General Requirements of a Surgical Operation —

2 Scalpels (No 4 handle with No 22 blades) (Fig 79)
4 Dissecting forceps (2 toothed and 2 plain each short and long)
24 Artery forceps (Spencer Wells)
12 Howard Kelly s forceps
2 Artery forceps (Kocher s, large)
6 Tissue forceps (Moynihan s Fig 80 or Allis s Fig 81)
2 Probes (large and small)
2 Surgeon s scissors (straight and curved)
1 Suture scissors
4 Sponge holding forceps
4 Retractors (Kocher s 2 large and 2 small) (Fig 83)
2 Retractors (large blunt, single hook)
2 Retractors (Langenbeck s)
1 Deep retractor



FIG 79 Bard Parker scalpel handle and replaceable blades

2 Aneurysm needles or MacCormick s dissectors (short) (Fig 84)
1 Copper spatula
8 Sutures needles (straight cutting edge three eighths and half circle round bodied small trocar pointed)
2 Needle holders (Matthieu s Fig 85 Hegar s or Higgs Fig 86)
2 Sucker heads
6 Towel clips (Mayo s Fig 87)
1 Director St Mark s Hospital pattern (Fig 88)
1 Catgut tube breaker
2 Ligature carriers
1 Volkmann s spoon (Fig 89)
1 Sinus forceps (Lister s)
Drain tubes

Skin Grafting

1 Skin grafting knife (Thiersch s or Humby s) or Dermatome and cement
1 Scissors (fine)
2 Dissecting forceps (fine, non toothed)
2 Flat boards
1 Steel rule
1 Mapping pen
1 Scalpel (No 3 handle with No 15 blades)
2 Scalpels (No 4 handle with No 15 blades)
2 Skin hooks (Gillies or Kilner s)
4 Mosquito pressure forceps
1 Sucker (fine)
2 Claw retractors (small)
2 Needle holders (Gillies or Dunhill s)
4 Needles (fine curved cutting edged)

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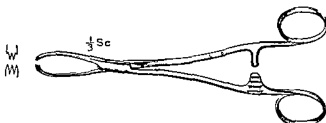


FIG 80 Moynihan s tissue forceps

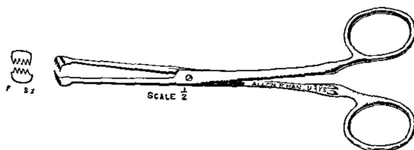


FIG 81 Allis peritoneum forceps

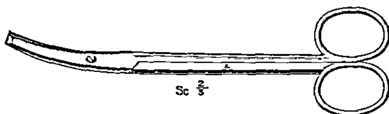


FIG 82 Devine s scissors chisel edged

FIG 83 Kocher s retractor

FIG 84 MacCormick s dissector and aneurysm needle

FIG 85 Matthieu s needle holder

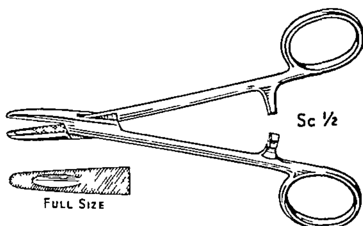


Fig 86 Higgs needle holder 6 inch

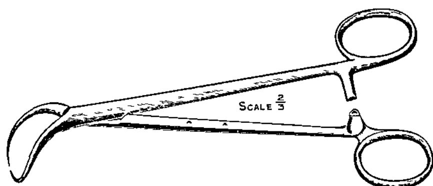


Fig 87 Mayo s towel clip



Fig 88 St Mark s Hospital pattern fistula director probe pointed



Fig 89 Volkmann s spoon

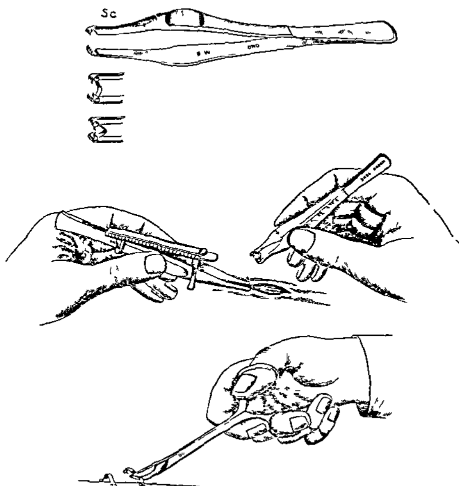


FIG 90 Michel's clips with application forceps apposition forceps for the skin edges magazine and extraction forceps

Michel's clips may be used on wound edges instead of sutures When one jaw of the extraction forceps is inserted under the clip and the forceps closed the clip straightens out and it may be removed

Mastisol and brush
Tulle gras or Porowax gauze
Rubber sponge or dental composition
Flavine emulsion or sterile liquid paraffin
Cotton wool
2 Crepe bandages
Splint or plaster of Paris bandages

OPERATIONS ON THE HEAD AND NECK

Craniotomy

GENERAL REQUIREMENTS OF A SURGICAL OPERATION
2 Periosteal elevators (curved and straight)
3 Trephines or burrs (Figs 91 and 92) ($\frac{1}{2}$ $\frac{3}{4}$ and 1 inch diameter)
1 Skull elevator (bone or disc elevator)

1 Dura mater separator (Horsley s Fig 93)
1 Dura mater forceps
1 Skull cutting forceps (de Vilbiss Fig 94)
24 Artery forceps (small)
2 Gigli s saws with director and guide (Figs 94 and 95)

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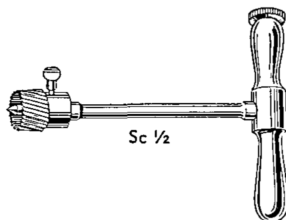
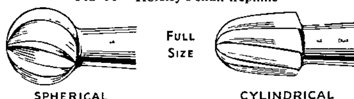


Fig 91 Horsley s skull trephine



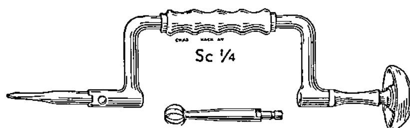


Fig 92 Hudson s brace and burrs

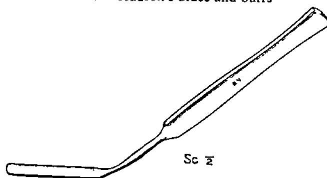


Fig 93 Horsley s dura mater separator

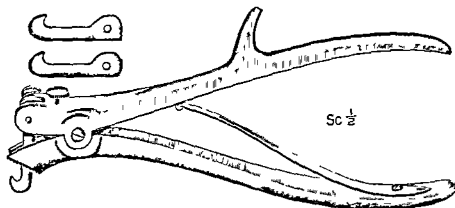


Fig 94 De Vilbiss skull cutting forceps with spare blades

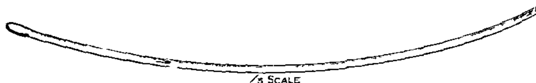


Fig 95 De Martel s guide for Gigli s saws



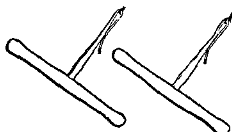


Fig 96 Olivecrona s modified Gigli thread saw with handles

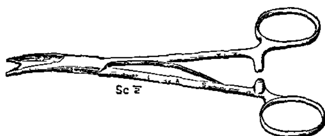


FIG 97 McKenzie s modification of Cushing s clip holding forceps

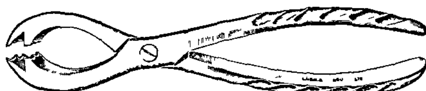


FIG 98 Fergusson s lion toothed bone holding forceps

1 Ventricular needle
1 Exploring syringe
2 Mastoid retractors
2 Brain retractors
2 Needles (small fine, curved round bodied for dura mater)
4 Needles (medium sized curved cutting edged)
4 Needles (straight, cutting edged)
Horsley s wax

Excision of Upper or Lower Jaw

GENERAL REQUIREMENTS OF A SURGICAL OPERATION
1 Tooth extraction forceps (upper or lower stump forceps)
1 Bone cutting forceps
1 Lion toothed forceps (Fergusson s Fig 98)
1 Sequestrum forceps
1 Finger saw
2 Gigli s saws with guide
1 Vulsellum forceps
1 Chisel and mallet
1 Periosteal elevator
Tracheostomy or laryngotomy instruments

Excision of the Tongue

GENERAL REQUIREMENTS OF A SURGICAL OPERATION
1 Mouth gag
1 Cheek retractor
2 Periosteal elevators (straight and curved)

(*Continued overleaf*)

1 Saw (finger or Gigli s)
1 Bone cutting forceps
1 Lion toothed forceps (Fergusson s)
1 Sequestrum forceps
1 Vulsellum forceps
1 Bone drill and bits
Tracheotomy or laryngotomy instruments
Silver wire and wire cutter

Removal of Lymphatic Glands or Thyroidectomy

General Requirements of a Surgical Operation
1 Thyroid dissector (Kocher s Fig 101)
3 Thyroid gland forceps (Kocher s or Lahey s Fig 99)
36 Artery forceps (small)
Dunhill s thin rubber drain tube

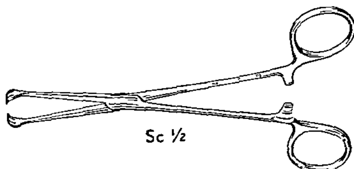


Fig 99 Lahey s thyroid holding forceps

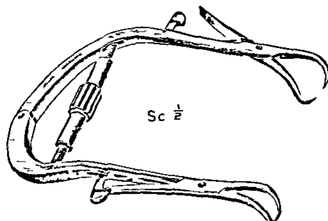


Fig 100 Joll s goitre retractor

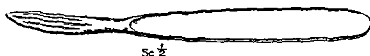


FIG 101 Kocher s thyroid dissector

Tonsillectomy and Removal of Adenoids

1 Mouth gag (*e g* Boyle Davis with jack, Figs 102 and 103)
1 *Tongue depressor* (Fig 105)
2 Tonsil dissectors
1 Pillar retractor
1 Scalpel (No 7 handle with No 15 blades)
4 *Sponge holding forceps*
1 Tonsil holding forceps (Luc s or Denis Browne s Fig 106)
1 Tonsil snare and extra wires
1 Tonsil scissors
3 *Tonsil artery forceps*
1 Dissecting forceps (long)
1 Needle holder (long)
2 Tonsil needles
2 Post nasal adenoid curettes (plain small and large)
1 Post nasal adenoid curette (with hooks and cage)
Suction apparatus
1 Head light

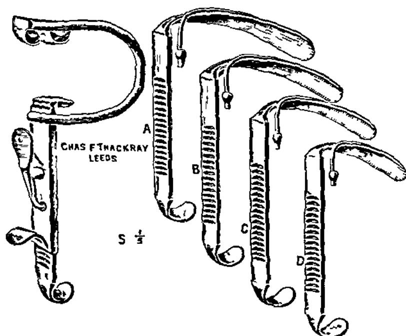


FIG 102 Boyle Davis mouth gag with four sizes of tongue blades

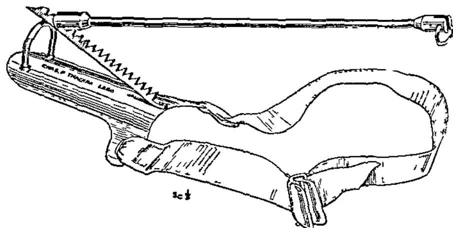


FIG 103 Guy s Hospital pattern jack and breast plate for Boyle Davis mouth gag with webbing strap

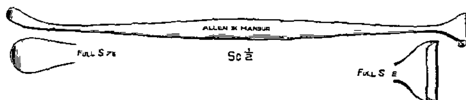


FIG 104 Beavis tonsil enucleator and pillar retractor

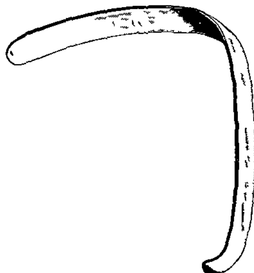


FIG 105 Lack s tongue depressor two sizes are available

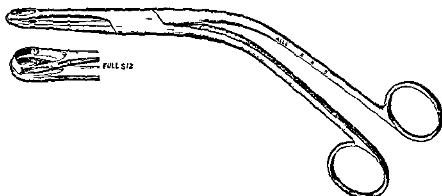


Fig 106 Denis Browne's tonsil holding forceps

Submucous Resection of the Nasal Septum

1 Scalpel (No 3 handle with No 15 blades)
3 Nasal specula (short, long and medium blades)
1 Septum knife (angular)
1 Septum dissector (Freer's)
1 Swivel knife (Ballenger's)
2 Luc's forceps (small and large)
1 Jansen Middleton's rongeur
1 Nasal packing forceps (angled)
1 Suction tip (angled) and suction apparatus
1 Nasal chisel or gouge
1 Mallet

Removal of Nasal Polypus

2 Nasal specula
2 Nasal snares
1 Nasal packing forceps
1 Suction apparatus
1 Scissors
2 Nasal forceps (Luc's)

Intranasal Antrostomy

2 Nasal specula (including small size No 1)
1 Raspatory with elevator (Hill's)
1 Nasal forceps (Luc's)
1 Antrum punch (Citelli's)
1 Nasal dressing forceps
1 Set of antrum burrs
Suction apparatus
Head mirror and lamp

Radical Antrostomy (Caldwell-Luc Operation)

REQUIREMENTS FOR INTRANASAL ANTROSTOMY

- 4 Artery forceps (Spencer Wells)
- 1 Retractor (Hajek's)
- 1 Scalpel (No 3 handle with No 10 blade)
- 3 Mastoid gouges (various sizes)
- 1 Mallet
- 1 Nasal punch forceps (Grunwald's Fig 107)
- 2 Volkmann's spoons (small and medium)
- 2 Needles (curved, small)
- 1 Needle holder
- 1 Sinus forceps
- 2 Scissors (straight and curved)
- 2 Towel clips

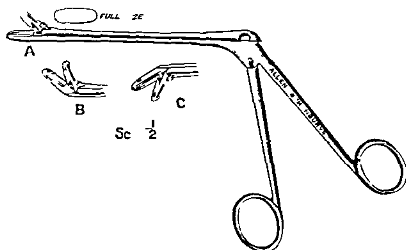


FIG 107 Grunwald's nasal punch forceps

Frontal Sinus Operation

- 1 Scalpel (No 3 handle with No 10 blades)
- 12 Artery forceps
- 1 Tissue forceps
- 1 Raspatory with elevator (Hill's)
- 4 Gouges (various sizes)
- 4 Chisels (various sizes)
- 1 Mallet
- 1 Probe (small)
- 1 Scissors (curved)
- 2 Volkmann's spoons
- 2 Needles (small curved)
- 1 Needle holder
- 2 Dissecting forceps

2 Towel clips
1 Punch forceps (Citelli s)
1 Mastoid hook retractor (self retaining)
2 Retractors (sharp, 4 pronged)
1 Punch forceps (Grunwald s)
1 Nasal speculum
1 Head light
Suction apparatus

Laryngofissure

REQUIREMENTS FOR TRACHEOSTOMY (Page 311)
12 Artery forceps (small)
2 Scissors (one stout)
2 Kocher s retractors (small)
1 Small saw (Joseph's or Hey's)
6 Towel clips
Cocaine solution (as ordered)
1 Syringe (1 ml) and needles
4 Sponge holding forceps

Laryngectomy

REQUIREMENTS FOR TRACHEOSTOMY (Page 311)
1 No 14 or No 16 Rubber catheter with terminal opening
24 Artery forceps (small)
Tracheostomy tubes (as ordered)
Rubber drainage tubing (thin)
1 Bone cutting forceps
No 3/0 and No 5/0 Chromic catgut on curved atraumatic needles
6 Towel clips
4 Sponge holding forceps

Paracentesis Tympani

3 Aural specula of various sizes
1 Packing forceps (angled)
1 Paracentesis needle or myringotomy knife
1 Aural suction tube (No 7) and suction apparatus
1 Scissors

Removal of Aural Polypus

3 Aural specula of various sizes
2 Aural polypus snares
1 Special aural polypus forceps (flat or cup ended)
1 Aural packing forceps (angled)
1 Scissors
1 Aural suction tube (No 9)
Suction apparatus

Endaural Mastoidectomy or Fenestration

Dental engine and special mastoid burrs
4 Mastoid gouges of various sizes
1 Mallet
1 Endaural speculum
1 Scalpel (No 3 handle with No 11 and No 15 blades)
Special endaural knives
2 Mastoid retractors (sharp, 4 pronged)
1 Self retaining endaural retractor
2 Endaural dissectors

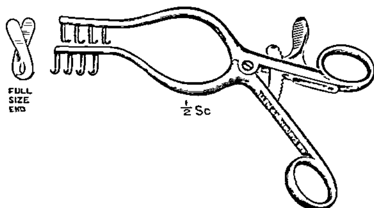


FIG 108 Mollinson s mastoid retractor

3 Mastoid curettes (sizes 2/0 3/0 4/0)
2 Suction points (Nos 7 and 9 aural)
Suction apparatus
1 Pericranial elevator
2 Irrigating bulbs
1 Aural forceps (angled)
1 Mastoid seeker
6 Artery forceps (small)
1 Head light
1 Needle holder

Mobilization of the Stapes

Set of special mobilization instruments (Rosen)
3 Aural specula of various sizes
1 Aural packing forceps (angled)
1 Head light suction apparatus

Post Auricular Mastoidectomy or Fenestration

4 Mastoid gouges (different sizes)
Dental engine and burrs (if requested)

1 Ear speculum
1 Scalpel (No 4 handle with No 22 blades)
12 Artery forceps, small
2 Dissecting forceps
Suction apparatus and aural suction tips
1 Needle holder
4 Towel clips
1 Periosteal elevator
1 Mastoid retractor (self retaining)
2 Mastoid retractors (4 prong sharp)
Curved needles
3 Mastoid curettes (various sizes)
Special dental burrs dissectors and flap knives for fenestration

Repair of Cleft Palate

1 Cleft palate gag (Lane s or Sydenham s)
2 Cleft palate raspatories (right and left)
2 Cleft palate forceps (toothed and plain)
2 Cleft palate knives (sharp and blunt pointed)
1 Cleft palate scissors
2 Aneurysm needles (fine)
4 Sponge holders
2 Cleft palate hooks
6 Mosquito pressure forceps
6 Needles (Lane s half circle cleft palate)
3 Needles (Denis Browne s cleft palate)
1 Cleft palate needle holder (Denis Browne s)
2 Sucker heads

OPERATIONS ON THE LIMBS

Amputation of a Limb or Excision of a Joint

General Requirements of a Surgical Operation
Pneumatic tourniquet or Esmarch s bandage
2 Amputation knives or large scalpels
1 Amputation saw
2 Gigli s thread saws
1 Bone cutting forceps
1 Sequestrum forceps
1 Lion toothed forceps (Fergusson s)
2 Rugines (Farabœuf s straight and curved)
1 Amputation flap retractor
1 Volkmann s spoon
Horsley s wax



Fig 109 Liston s bone cutting forceps

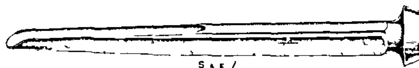


Fig 110 St Thomas s Hospital pattern gouge

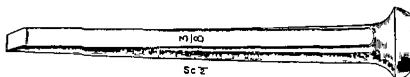


Fig 111 Bone chisel

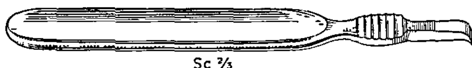


Fig 112 Farabœuf s rugine with curved blade

Osteotomy

General Requirements of a Surgical Operation
- Pneumatic tourniquet or Esmarch s bandage
- 2 Osteotomes
- 2 Chisels (Fig 111) and mallet
- 1 Periosteotomy saw (Adam s)

Sequestrectomy

General Requirements of a Surgical Operation
- 2 Rugines (Farabœuf s straight and curved Fig 112)
- 1 Chisel and mallet
- 3 Gouges (¼ ½ and 1 inch)
- 1 Sequestrum forceps
- 1 Gouge forceps
- 2 Volkmann s spoons (large and small)
- 2 Sucker heads

Operation for Compound Fracture and for Ununited Fracture

General Requirements of a Surgical Operation
- Pneumatic tourniquet or Esmarch s bandage
- 2 Chisels and mallet
- 1 Sequestrum forceps

1 Bone cutting forceps
2 Bone holding forceps
1 Bone elevator (Lane s)
Electric saw and blades
1 Plate holder (Lane s)
2 Rugines (Farabœuf s straight and curved)
Bone plates and screws (Vitallium or tantalum)
1 Screw driver and holder (Sherman s)
1 Bone drill and bits

Tenotomy

GENERAL REQUIREMENTS OF A SURGICAL OPERATION
2 Tenotomy knives (sharp and blunt pointed Fig 113)



FIG 113 Tenotomy knife

Intravenous Infusion See Chapter 12

OPERATIONS ON THE TRUNK

Amputation of the Breast

GENERAL REQUIREMENTS OF A SURGICAL OPERATION
2 Scalpels (large)
36 Artery forceps
6 Towel clips

Thoracotomy and Thoracoplasty

GENERAL REQUIREMENTS OF A SURGICAL OPERATION
1 Exploratory syringe and needles or aspirator
2 Rib raspatories (Doyen s right and left Fig 114)
2 Periosteal elevators (straight and curved)
1 Bone nibbling forceps
2 Rib retractors with keys (Tuffier s)
1 Rib approximator (Roberts Nelson s Fig 115)
1 Rib shears (Fig 116)
2 Dissecting forceps (long)
2 Thoracotomy drain tubes
1 Apparatus for underwater drainage
1 Lion toothed forceps (Fergusson s)
1 Bone cutting forceps

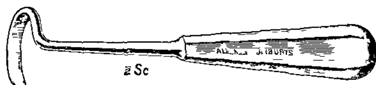


Fig 114 Doyen's curved rib raspatory This instrument is also supplied with a curve to the right

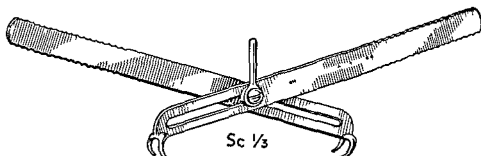


Fig 115 Roberts Nelson's rib approximator

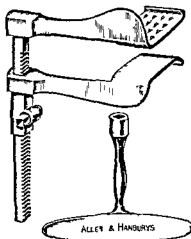


Fig 116 Wakeley's modification of Tuffier's rib retractor

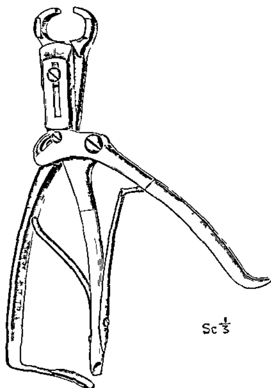


Fig 117 Vermehren's rib shears

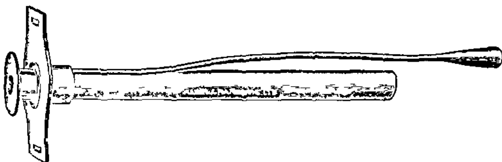


FIG 118 Tudor Edward s empyema tube with adjustable flange avail able in sizes 42 45 48 and 51 French catheter gauge

Pneumonectomy and Lobectomy

REQUIREMENTS FOR THORACOTOMY

1 Needle holder (Tudor Edward s Fig 118)
4 Lung forceps (Duval s Fig 119)
1 Scissors (long)

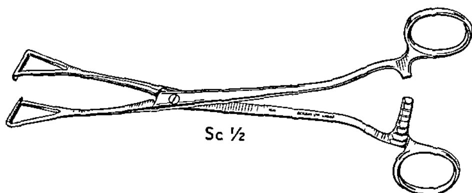


FIG 119 Duval s lung forceps

Operations on the Heart and Great Vessels

REQUIREMENTS FOR PNEUMONECTOMY

3 Pulmonary artery clamps (Blalock s Fig 120)
3 Aortic clamps (Pott s)
2 Ductus clamps (Pott s)
2 Commissure knives (anterior and posterior)
4 Coarctation clamps (Crafoord s)
1 Expanding dilator (Sellor s or Brock s)
1 Infundibular punch (Brock s)
1 Nystrom s probe with rubber tubing
1 Nystrom s pulmonary artery clamp
4 Needles (size 4/0 eyeless with braided nylon)

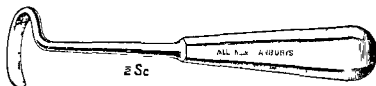


FIG 114 Doyen's curved rib raspatory This instrument is also supplied with a curve to the right

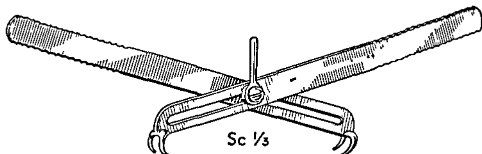


FIG 115 Roberts Nelson's rib approximator

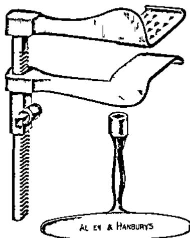


FIG 116 Wakeley's modification of Tuffier's rib retractor

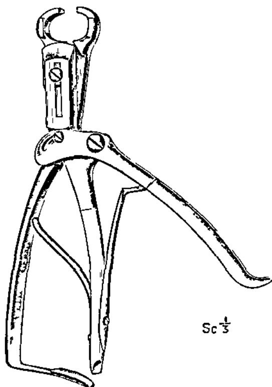


FIG 117 Vermehren's rib shears

1 Iris scissors
1 Dissecting forceps (toothed, fine)
1 Tenotomy knife (sharp pointed)

OPERATIONS ON THE ABDOMEN

Exploratory Laparotomy, *i e* instruments required for every abdominal operation

GENERAL REQUIREMENTS OF A SURGICAL OPERATION

Exploring syringe and needle
1 Abdominal retractor (self retaining Balfour s Fig 122)
4 Deaver s retractors (large and small Fig 123)
4 Gall bladder forceps (Moynihan s)
4 Intestinal forceps (rubber covered)
2 MacCormick s dissectors (long)
2 Duval s or Babcock s forceps (Fig 124)
2 Surgeon s scissors (long straight and curved)
1 Needle holder (long Thomson Walker s)
1 Vulsellum forceps
4 Sponge holding forceps
1 Dissecting forceps (long non toothed)
4 Intestinal clamps (Payr s Fig 125, or Parker Kerr s Fig 128)
Paul s intestinal drainage tubing (various sizes) and rubber tubing
1 Colostomy rod
6 Intestinal needles (straight three eighths and half circle)

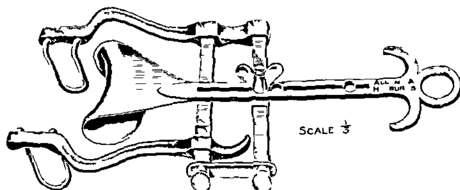


FIG 122 Balfour s abdominal self retaining retractor

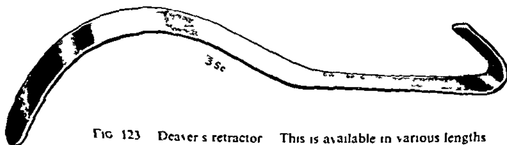


FIG 123 Deaver s retractor This is available in various lengths and widths

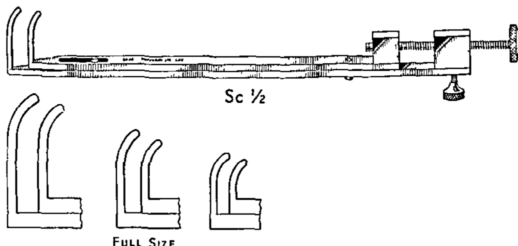


FIG 120 Blalock s pulmonary artery clamp

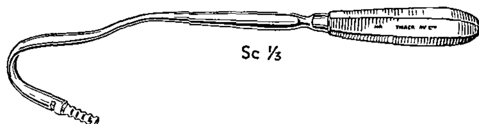


FIG 121 *Nystrom s modified Trendelenburg s probe with bayonet fitting mount for rubber tubing*

Minor Rectal Operations

GENERAL REQUIREMENTS OF A SURGICAL OPERATION
- 1 Rectal speculum
- 3 Probes fine (small medium and large)
- 1 Probe with eye
- 1 Volkmann s spoon (small)
- Heavy suture material

Laminectomy

GENERAL REQUIREMENTS OF A SURGICAL OPERATION
- 1 Self retaining laminectomy retractor
- 1 Rugine
- 2 Periosteal elevators (straight and curved)
- 1 Laminectomy saw (Horsley s or Doyen s)
- 2 Prismatic bone cutting forceps (straight and angular, Horsley s)
- 1 Laminectomy forceps (Hudson s)
- 1 Gouge forceps
- 1 Lion toothed forceps (Fergusson s)
- 2 Volkmann s spoons (large and small)
- 1 Strong scissors

1 Iris scissors
1 Dissecting forceps (toothed fine)
1 Tenotomy knife (sharp pointed)

OPERATIONS ON THE ABDOMEN

Exploratory Laparotomy, *i e* instruments required for every abdominal operation

GENERAL REQUIREMENTS OF A SURGICAL OPERATION
Exploring syringe and needle
1 Abdominal retractor (self retaining Balfour s, Fig 122)
4 Deaver s retractors (large and small Fig 123)
4 Gall bladder forceps (Moynihan's)
4 Intestinal forceps (rubber covered)
2 MacCormick s dissectors (long)
2 Duval s or Babcock s forceps (Fig 124)
2 Surgeon's scissors (long straight and curved)
1 Needle holder (long Thomson Walker s)
1 Vulsellum forceps
4 Sponge holding forceps
1 Dissecting forceps (long non toothed)
4 Intestinal clamps (Payr s, Fig 125 or Parker Kerr s, Fig 128)
Paul s intestinal drainage tubing (various sizes) and rubber tubing
1 Colostomy rod
6 Intestinal needles (straight three eighths and half circle)

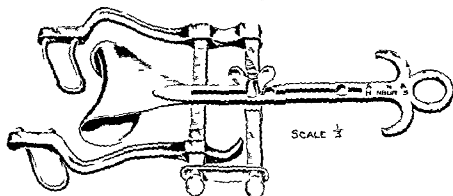


FIG 122 Balfour s abdominal self retaining retractor

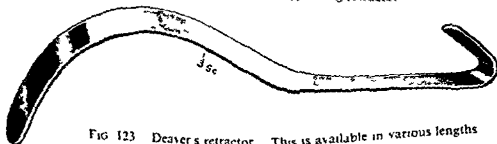


FIG 123 Deaver s retractor This is available in various lengths and widths

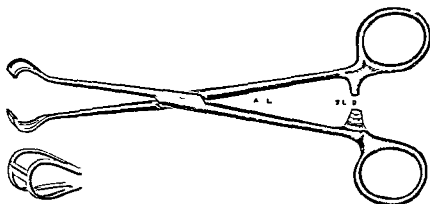


Fig 124 Babcock's tissue forceps

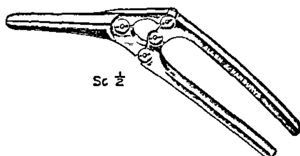


Fig 125 Payr's intestinal crushing clamp A similar clamp for use on the stomach has a 4 inch or a 5¼ inch blade

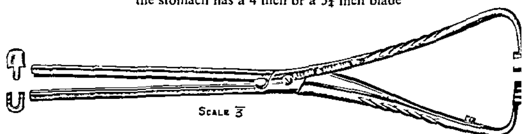


Fig 126 MacCormick's crushing stomach clamp with 5½ inch blades A similar clamp for use on the bowel has 3 inch blades

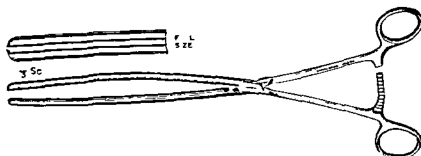


Fig 127 Kocher's intestinal clamp

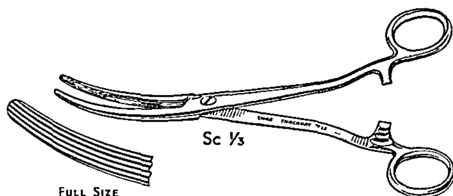


FIG 128 Parker Kerr s intestinal clamp

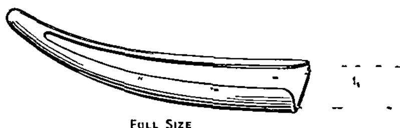


FIG 129 Lloyd Davies shields

After division of the bowel between Parker Kerr clamps one of these shields is slipped over the end of each clamp as a safeguard against soiling of the peritoneum

Gastro enterostomy or Gastrectomy

GENERAL REQUIREMENTS OF AN EXPLORATORY LAPAROTOMY

2 Stomach clamp forceps (Moynihan s or Payr s)
1 Strabismus scissors (straight)

Appendicectomy

GENERAL REQUIREMENTS OF A SURGICAL OPERATION

Gall Bladder Operations

GENERAL REQUIREMENTS OF AN EXPLORATORY LAPAROTOMY

1 Gall bladder scoop
3 Bile duct forceps (Maingot s Fig 130)
1 Bile duct forceps (Desjardin s)
1 Bile duct probe
2 Needles (fine small half-circle)
1 Set cervical dilators or urethral sounds

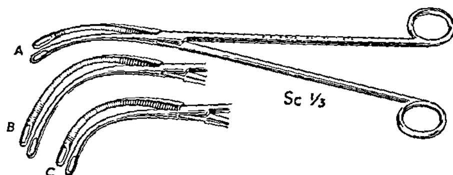


FIG 130 Maingot's bile duct forceps



FIG 131 Moore's bile spoon

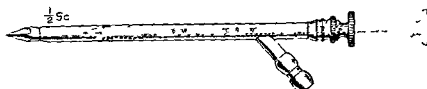


FIG 132 Ochsner's gall bladder trocar with metal piston and side branch

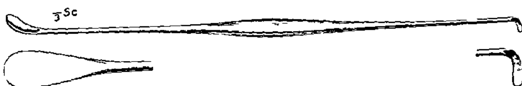


FIG 133 Cheatle's gall bladder scoop and hook

Herniorrhaphy (routine operation)
GENERAL REQUIREMENTS OF A SURGICAL OPERATION

Repair of Strangulated Hernia
GENERAL REQUIREMENTS OF AN EXPLORATORY LAPAROTOMY
1 Hernia director

Excision of the Rectum (Abdomino perineal perineal anterior or other restorative resection)
GENERAL REQUIREMENTS OF AN EXPLORATORY LAPAROTOMY
Paquelin's cautery

1 Set of intestinal clamps (Cope s modification of de Martel s) (Fig 134)
1 Catheter
4 Artery forceps (long straight)
2 Bowel or pedicle clamps (long, curved)
1 Chisel and mallet

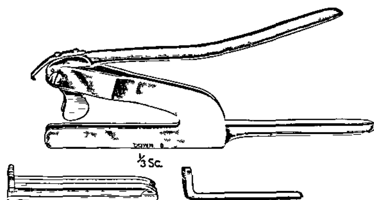


Fig 134 Zachary Cope s set with three stainless steel clamps a lever action closing device and a tommy for opening

1 Lion toothed forceps (Fergusson s)
1 Bone cutting forceps
4 Perineal retractors (Young s)
2 Bladder retractors (Fig 135)
2 Intestinal forceps (Parker Kerr)

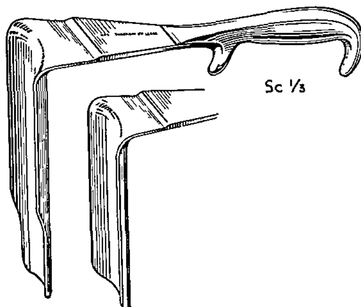


Fig 135 St Mark s Hospital pattern pelvic retractors 7 and 5 inches deep

Excision of the Rectum (Synchronous combined method) Two separate sets of instruments are required

(i) Abdominal portion

GENERAL REQUIREMENTS OF AN EXPLORATORY LAPAROTOMY
- 4 Artery forceps (long, straight)
- 2 Bladder retractors (Muir s or St Mark s)

(ii) Perineal portion

- 1 Self retaining abdominal retractor
- 4 Perineal retractors (Young s)
- 2 Needle holders (Matthieu s Hegar s or Higgs)
- 1 Long needle holder (Thomson Walker s)
- 2 Scalpels
- 1 Lion toothed forceps (Fergusson's)
- 1 Chisel and mallet
- 1 Bone cutting forceps
- 3 Dissecting forceps with teeth
- 1 Dissecting forceps (non toothed)
- 12 Artery forceps (short)
- 6 Artery forceps (long)
- 3 Sponge holding forceps
- 2 Surgeon s scissors (long and medium straight)
- 1 Suture scissors
- 2 Extra pairs of gloves
- 4 Needles (fine large cutting edged Colt s)
- 2 Needles (fine small, curved, round bodied)
- 1 Aneurysm needle
- 2 Deaver s retractors (large and small)

GYNÆCOLOGICAL OPERATIONS

Abdominal Hysterectomy or Salpingo oophorectomy

GENERAL REQUIREMENTS OF AN EXPLORATORY LAPORATOMY
- 4 Hysterectomy clamp forceps (curved)
- 1 Myoma hook or corkscrew (Doyen s)
- 4 Trocar pointed needles

Curettage
- Uterine dilators (Hegar s Fig 136)
- 3 Vaginal specula (Sim s Auvard s, Fig 138 and Cusco s Fig 140)
- 1 Uterine vulsellum forceps
- 2 Uterine curettes (sharp and blunt)
- 1 Uterine sound

(*Continued on page* 182)

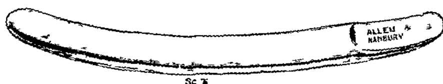


FIG 136 Hegar s uterine dilator Twenty five sizes are available

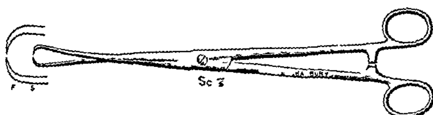


FIG 137 Uterine vulsellum forceps

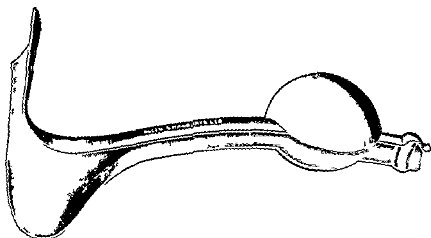


FIG 138 Auvard s vaginal speculum



FIG 139 Sim s vaginal speculum Three sizes are available

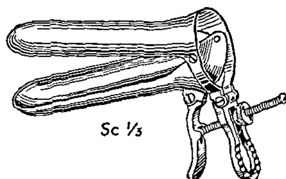


Fig 140 Cusco s vaginal speculum This is available in three sizes

Sc ⅓





Full Size



Full Size

Fig 141 Playfair s uterine probes with roughened and spiked ends

1 Uterine probe (Playfair s Fig 141)
1 Uterine forceps
1 Ovum forceps
4 Sponge holding forceps
1 Uterine tube (Bozemann s irrigating tube, Fig 142)

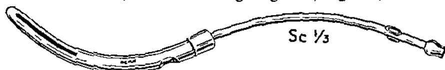


Fig 142 Bozemann s flushing tube three sizes

Perineorrhaphy, Trachelorrhaphy or Colporrhaphy

General Requirements of a Surgical Operation
Requirements of a Curettage
1 Uterine vulsellum forceps
2 Trachelorrhaphy needles
1 Perineorrhaphy scissors (Lawson Tait s)
1 Vaginal speculum (Cusco s)

GENITO URINARY OPERATIONS

Nephrectomy or Nephrolithotomy

General Requirements of a Surgical Operation
2 Abdominal retractors (deep)
2 Periosteal elevators (straight and curved)

1 Bone cutting forceps
1 Ureteral stone forceps
1 Ureteral scoop (Thomson Walker s)
2 Kidney stone forceps
2 Liver needles (Cullen s)
4 Pedicle clamps

Suprapubic Cystostomy

GENERAL REQUIREMENTS OF A SURGICAL OPERATION
2 Catheters (Jaques rubber and silver)
1 Bladder syringe
1 Self retaining bladder retractor
1 Needle holder (Swift Joly s)
1 Lithotomy scoop
1 Lithotomy forceps
4 Half circle intestinal suture needles
1 Bladder forceps
Drainage tubes (Freyer s or de Pezzer s)

Litholapaxy

Urethral bougies (Lister s sizes 6 to 18)
1 Scalpel (fine bladed)
Lithotrite and evacuation apparatus with evacuating cannulæ and stylets
2 Catheters (Jaques rubber and silver)
1 Bladder irrigator or bladder syringe

External Urethrostomy

GENERAL REQUIREMENTS OF A SURGICAL OPERATION
2 Catheters (Jaques rubber and silver)
1 Bladder syringe
1 Grooved staff (Wheelhouse's)
1 Lithotomy gorget (Teale s)

Internal Urethrotomy

1 Urethral irrigator
1 Filiform guide (pilot or conducting bougie)
1 Urethrotome (Thomson Walker s)
Urethral bougies (Lister s sizes 12 to 16)
2 Catheters (Jaques rubber and silver)
1 Scalpel (fine bladed)

Prostatectomy

REQUIREMENTS FOR SUPRAPUBIC CYSTOSTOMY
1 Bladder scissors (Thomson Walker s)
2 Boomerang needle holders (sharp and blunt Fig 143)

(*Continued overleaf*)

1 Ligature carrying forceps (Young s or Harris')
1 Bladder neck spreader (Millin s)
4 T-shaped hæmostatic capsule forceps (Millin's)
Diathermy set and electrodes

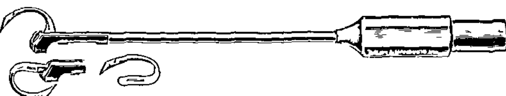


FIG 143 Harris boomerang needle

OPERATIONS ON THE EYE

General Requirements of all Eye Operations

1 Undine
2 Syringes (2 and 5 mls)
2 Needles (3 and 5 cms)
1 Speculum (Bowman s Fig 145)

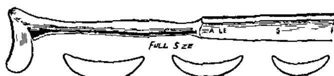


FIG 144 Desmarres eyelid retractor three sizes

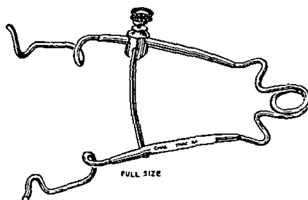


FIG 145 Bowman s eye speculum with fixing screw

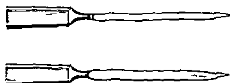


FIG 146 Von Graefe s cataract knives

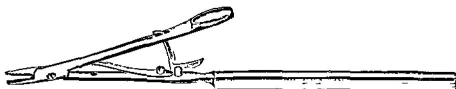


FIG 147 Silcock s needle holder

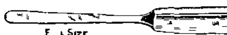


FIG 148 Snell s iris repositor

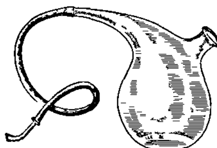


FIG 149 Bishop Harman s irrigator for the anterior chamber consisting of an undine rubber tubing and a silver cannula

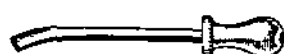


FIG 150 Lang s silver cannula for washing the anterior chamber

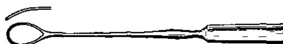


FIG 151 Snellen s vectis

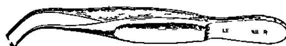


FIG 152 Hess iris forceps

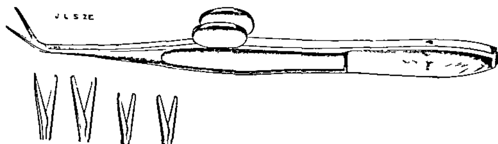


FIG 153 De Wecker s eye scissors

1 Fixation forceps
1 Conjunctival forceps
1 Conjunctival scissors
1 Eye needle holder (Stallard s or Silcock s)

Additional Requirements of Operations on the Eye

Cataract Extraction

2 Cataract knives (von Graefe s Fig 146)
1 Suture scissors
2 Iris forceps (straight and curved)
1 Iris scissors (de Wecker s)
1 Intracapsular forceps
1 Capsule forceps
1 Cystotome
1 Lens expressor
2 Curettes
1 Iris hook (blunt)
2 Iris repositors
1 Anterior chamber irrigator (Fig 149)
1 Vectis (Fig 151)
1 Corneal scissors
1 Testing drum
2 Retractors (Desmarres)
2 Needles (eyeless corneo scleral with silk attached)

Needling (Discission)

2 Cataract needles
1 Testing drum
1 Ziegler s capsulotomy knife (Fig 154)

Iridectomy

1 Keratome or narrow cataract knife (small von Graefe s
2 Iris forceps (straight and curved Fig 152)
1 Iris hook
1 Iris scissors (De Wecker s Fig 153)
4 Iris repositors
1 Anterior chamber irrigator
4 Mosquito pressure forceps
1 Testing drum (Fig 155)
1 Eye spatula

Trephine Operation

1 Tooke s knife
1 Trephine (1 5 or 2 mms Fig 156)
2 Iris forceps (straight plain and toothed)
1 Iris scissors (De Wecker s)
1 Scleral disc forceps (Elliot s)
1 Scissors (small sharp pointed)
4 Iris repositors
1 Probe and spirit lamp



FIG 154 Ziegler s capsulotomy knife

Paracentesis

1 Broad needle or keratome
2 Iris repositors
1 Curette
1 Lens expressor
1 Anterior chamber irrigator
1 Iris forceps
1 Iris scissors

Enucleation

1 Scissors (large curved)
1 Strabismus hook
1 Strabismus scissors
4 Mosquito pressure forceps (curved)
1 Scalpel (No 3 handle with No 10 blades)
2 Needles (fine curved)

Evisceration

1 Cataract knife
1 Corneal scissors
1 Nasal speculum
4 Mosquito forceps
1 Spoon
1 Evisceration scoop

Removal of Pterygium

1 Cataract knife

Correction of Squint (Strabismus)

1 Sharp ended scissors
1 Blunt-ended scissors
2 Squint hooks
1 Calipers
1 Steel rule (millimetres)
1 Strabismus forceps
2 Advancement forceps
1 Pair dividers
2 Mosquito forceps
1 Curette
4 Needles (fine curved)

Additional Requirements of Operations on the Eye

Cataract Extraction

2 Cataract knives (von Graefe s Fig 146)
1 Suture scissors
2 Iris forceps (straight and curved)
1 Iris scissors (de Wecker's)
1 Intracapsular forceps
1 Capsule forceps
1 Cystotome
1 Lens expressor
2 Curettes
1 Iris hook (blunt)
2 Iris repositors
1 Anterior chamber irrigator (Fig 149)
1 Vectis (Fig 151)
1 Corneal scissors
1 Testing drum
2 Retractors (Desmarres')
2 Needles (eyeless corneo scleral with silk attached)

Needling (Discission)

2 Cataract needles
1 Testing drum
1 Ziegler s capsulotomy knife (Fig 154)

Iridectomy

1 Keratome or narrow cataract knife (small von Graefe s
2 Iris forceps (straight and curved Fig 152)
1 Iris hook
1 Iris scissors (De Wecker s Fig 153)
4 Iris repositors
1 Anterior chamber irrigator
4 Mosquito pressure forceps
1 Testing drum (Fig 155)
1 Eye spatula

Trephine Operation

1 Tooke s knife
1 Trephine (1 5 or 2 mms Fig 156)
2 Iris forceps (straight plain and toothed)
1 Iris scissors (De Wecker s)
1 Scleral disc forceps (Elliot s)
1 Scissors (small sharp pointed)
4 Iris repositors
1 Probe and spirit lamp

Correction of Entropion

1 Entropion forceps
1 Curved scissors
6 Needles (fine and curved)
1 Scalpel (No 3 handle with No 15 blades)
1 Sucker
2 Retractors (small claw)



Fig 157 Nettleship s lacrimal dilator

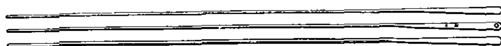


Fig 158 Lacrimal probes three sizes

Replacement of Detached Retina

2 Strabismus hooks of insulated material
4 Mosquito forceps
1 Diathermy apparatus with special terminals
1 Ivory depressor
1 Pair of dividers
1 Steel rule (millimetres)
1 Suction bulb and glass tube

Dacrocystorhinostomy

Requirements for Dacrocystectomy

1 Retractor (obtuse angled)
1 Retractor (Stallard s)
1 Nasal forceps
2 Mucoperiosteal elevators (Howarth s straight and angled)
1 Mastoid gouge and mallet
1 Chisel (small)
1 Sphenoid sinus forceps
1 Bone nibbling forceps (small)
2 Dacrocystorhinostomy needles on handles

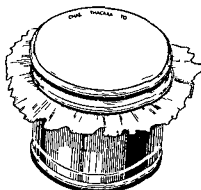


Fig 155 Trial drum covered with fine kid leather

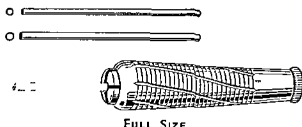


Fig 156 Elliot s sclerotomy trephine

Relief of Lacrimal Obstruction

1 Canaliculus dilator
1 Lacrimal syringe
4 Lacrimal probes (Anel s sizes 1–3 Fig 158)

Excision of Lacrimal Sac (Dacrocystectomy)

REQUIREMENTS FOR OPERATION ON LACRIMAL OBSTRUCTION

1 Punctum dilator
1 Lacrimal syringe and cannula
1 Scalpel (No 3 handle with No 15 blades)
1 Lacrimal retractor
1 Suction apparatus
6 Mosquito forceps
1 Blunt dissector (fine)
1 Dissecting forceps
2 Scissors (blunt pointed straight and curved)
1 Curette
1 Canaliculus rasp
1 Nasal speculum
1 Head light
2 Needles (fine and curved)
1 Sucker

1 Equipment and Drugs used for the Administration of Anæsthetics

A The Anæsthetic Agents

For Inhalation Anæsthesia —

Ether Supplied in coloured bottles containing 1 lb

Ethyl Chloride Supplied in 100 ml bottles with a special spray cork

Chloroform Supplied in coloured bottles containing 1 lb

Trilene (trichlorethylene) Supplied in 250 and 500 ml containers

Fluothane (halothane) Supplied in 50 and 250 ml bottles

Nitrous Oxide Supplied in 100, 200 and 1,800 gallon cylinders

Cyclopropane Supplied in 30 gallon cylinders

For Intravenous Anæsthesia —

Pentothal (sodium thiopentone)

Ampoules containing 250 and 500 mg for 2 5 per cent solution 500 and 1 000 mg for 5 per cent solution

Rubber capped vials for multiple administrations containing 2 5 Gm for 2 5 per cent solution

Chemically pure water

Ampoules of 10 20 and 100 ml for making up these solutions

Viadril (hydroxydione)

Ampoules containing 1 Gm for 2 5 per cent solution (This is usually further diluted to give 0 5 and 1 5 per cent solutions)

For Spinal Epidural Caudal and Regional Analgesia —

Nupercaine

(a) For Spinal Anæsthesia

Light Nupercaine (1 in 1,500 solution) Supplied in 20 ml ampoules

Heavy Nupercaine (1 in 200 solution) Supplied in 3 ml ampoules

(b) For Caudal Anæsthesia

1 in 600 solution Supplied in 30 ml ampoules

Decicain (Amethocaine Hydrochloride) For Spinal Anæsthesia

Light Amethocaine (1 in 1 000 solution) Supplied in 20 ml ampoules

Heavy Amethocaine (1 in 100 solution) Supplied in 3 ml ampoules

Novocaine (procaine hydrochloride)

(a) For Spinal Anæsthesia

Ampoules containing 50 and 300 mg

(b) For Regional and Epidural Anæsthesia

0 5 1 2 and 3 per cent solutions

Metycaine For Epidural Anæsthesia

1 5 per cent solution Supplied in 200 ml ampoules

CHAPTER 12

EQUIPMENT REQUIRED FOR THE ADMINISTRATION OF ANÆSTHETICS AND FOR ANÆSTHETIC EMERGENCIES

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THERE now follow three chapters which set out the nursing duties involved in the preparation for anæsthesia in assisting the anæsthetist during anæsthesia and in the care of the patients after anæsthesia It must be emphasized that in a book of this nature instruction in the administration of anæsthetics is not considered appropriate

This chapter (Chapter 12) contains —

1 A description of the general equipment in an Anæsthetic Department

2 An important list of the articles which must be prepared for ALL anæsthetics

3 Lists of equipment to be prepared for the particular anæsthetic which is to be administered

I GENERAL EQUIPMENT

The Anæsthetic Departments of hospitals are for the most part supplied with the following —

(i) Equipment and drugs used for the administration of anæsthetics

(ii) Equipment used for overcoming obstruction to the natural airway

(iii) Equipment used for blood transfusion and for the intravenous infusion of serum serum albumin glucose saline etc

(iv) Equipment for observation of the patient during anæsthesia

(v) Equipment and drugs for use in emergencies during anæsthesia

(vi) Equipment for continuous artificial respiration

The items which comprise each of these six classes are now discussed

Soda Lime This is used in gas machines, Waters canisters or resuscitators for the absorption of exhaled carbon dioxide

It is commonly of the 'Indicator' type which means that there is a change in colour when its absorbing power is exhausted

Supplied in 1 and 9 lb tins

Relaxing Agents These are used intravenously to supplement the anæsthetic agents and are usually employed to produce muscular relaxation at a lighter level of anæsthesia

Tubarine (d tubocurarine chloride)

Ampoules containing 15 and 20 mg in 1 5 and 2 ml

5 ml vials containing 10 mg per ml

Miscible Tubarine (which does not form a precipitate with sodium thiopentone)

Ampoules containing 15 mg in 1 5 ml

Flaxedil (gallamine triethiodide)

Ampoules containing 80 and 120 mg in 2 and 3 ml

Laudolissin

Ampoules containing 30 mg in 1 5 ml

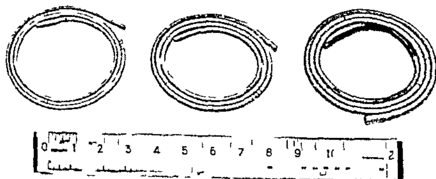


FIG 160 Ryle s tube on the left for comparison Levin s tube in the middle and Wangensteen s tube on the right The Levin and the Wangensteen tubes are for gastric and duodenal suction whereas the Ryle s tube is used to obtain specimens for gastric analysis The scale is in inches

Ryle s tubes are 30 36 and 42 inches long and 4 6 8 and 10 English catheter gauge They have four small lateral holes but no terminal hole The lower end is weighted by a concealed piece of metal and these tubes are marked I II–III–IIII at 14 20 25 and 29 inches from the lower end

The Levin tube is 105 and 125 cms long and 12 14 and 16 French catheter gauge It has four lateral holes but no terminal hole and it is marked I II–III–IIII at 36 52 65 and 75 cms from the lower end

The Wangensteen tube is 1 metre long and 7 8 and 9 English catheter gauge It has nine relatively large lateral holes but no terminal hole It is marked at 45 55 65 and 75 cms from the lower end The tip is opaque to X rays

Xylocaine (lignocaine hydrochloride) For Regional Caudal and Epidural Anæsthesia
0 5 1, 2, 4 and 5 per cent solutions

For Rectal Anæsthesia —
Avertin
Bottle of 25 and 100 ml
10 ml bottles of 1 in 1,000 Congo Red solution for testing the Avertin
Pentothal See above
5 or 10 per cent solution is usually employed

For Topical Anæsthesia —
Cocaine hydrochloride 2 to 20 per cent solution
Decicain 2 per cent solution
Xylocaine 4 per cent solution

B AUXILIARY AGENTS IN EVERYDAY USE DURING ANÆSTHESIA

Oxygen Supplied in cylinders containing 7 2, 14 4 and 120 cubic feet or from a piped supply This is used in all gas machines and resuscitators with a Waters canister or with a mask mount mask and rubber bag attachment

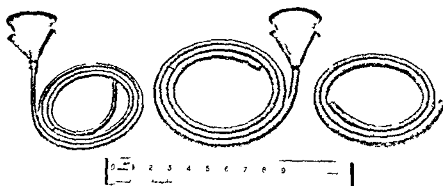


FIG 159 An adult size stomach tube in the middle with a child size stomach tube on the left and a Senoran s stomach tube on the right The scale is in inches

The adult size stomach tube is 5 feet long and up to 30 English catheter gauge It has a terminal hole and one lateral hole and it is 2 feet from the lower end to the mark (In the average adult it is 18 inches from the teeth to the junction between the œsophagus and the stomach) The child size stomach tube also has a terminal and a lateral hole it is 4 feet 10 inches long and up to 20 English catheter gauge in diameter It is 1 foot 8 inches from the lower end up to the mark

The Senoran tube is 110 cms long and 19 English catheter gauge it has a large lateral hole (1 5 cms × 0 5 cms) four small lateral holes (each 2 mms in diameter) and a terminal hole It has marks at 45 50 55 and 60 cms from the lower end

Pethidine Hydrochloride This is used as a supplementary anæsthetic agent and is given by intravenous injection

Ampoules containing 50 and 100 mg

25 and 50 ml rubber capped vials containing 50 mg per ml

Adrenalin This is used in conjunction with the agents for regional and topical anæsthesia as it causes a local vaso constriction and therefore prolongs the action of the local anæsthetic drugs (by preventing their rapid absorption and destruction)

Supplied as adrenaline hydrochloride or adrenaline tartrate, 1 in 1,000 solution

1 ml ampoules

10 and 25 ml rubber capped vials

C The Equipment for the Administration of the Above Agents

See Section 3 ' Lists of equipment to be prepared for the particular anæsthetic which is to be administered

ii Equipment Used for Overcoming Obstruction to the Natural Airway

Mouth Gag This instrument is used for holding open or if necessary forcing open the jaws of a patient in a light plane of anæsthesia who requires pharyngeal suction an oro pharyngeal airway the passage of a laryngoscope and intratracheal tube or even emergency bronchoscopy

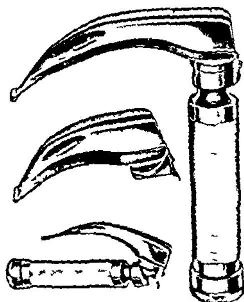


Fig 162 Macintosh s laryngoscope

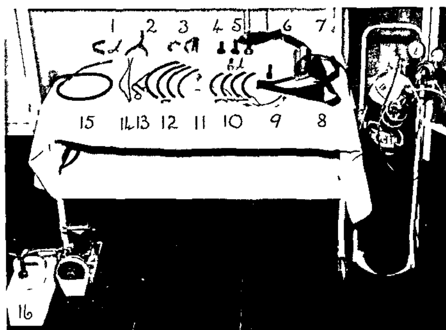


FIG 161 General set up for adult anæsthetics

1 Tongue depressor and Mayo type tongue forceps 2 Mouth gag 3 Laryngoscope with two sizes of blade 4 Airways three sizes 5 (behind the airways) 10 ml syringe and clip for the cuffed tubes 6 Bag for Waters canister 7 Waters canister connected to oxygen cylinder 8 Head harness 9 Intratracheal fitting for canister 10 Magill s endotracheal cuffed tubes sizes 6 to 10 and connexion 11 Lubricant for endotracheal tubes 12 Magill s endotracheal tubes without cuffs sizes 5 to 10 and connexion 13 Intubating forceps 14 Suction catheters (10 to 16 Fr) with connexions for the sucker tubing 15 Sucker head and 16 Sucker

Eulissin A (decamethonium iodide)
Ampoules containing 5 mg in 2 5 ml
Scoline (suxamethonium chloride)
Ampoules containing 100 mg in 2 ml
10 ml vials containing 100 mg per ml

Prostigmin This is employed for the reversal of the relaxing agents Tubarine Flaxedil and Laudolissin (not Scoline and Eulissin) and is given by intravenous injection

It must always be used in conjunction with atropine sulphate
1 ml amber ampoules containing 2 5 mg
1 ml colourless ampoules containing 0 5 mg
5 ml vials containing 2 5 mg per ml

Atropine Sulphate
Ampoules containing 0 432 mg (gr 1/150) 0 648 mg (gr 1/100) and 1 296 mg (gr 1/50)

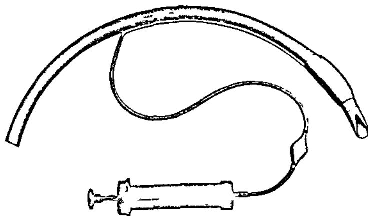


FIG 164 Magill s tube with inflatable cuff

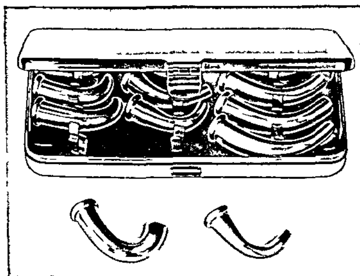


FIG 165 Magill s connections
These are supplied in sizes 1 to 6 for use with oral tubes in sizes 7 to 12 for use with nasal tubes

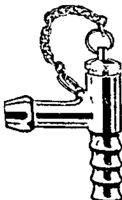


FIG 166 Cobb s connection

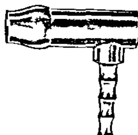


FIG 167 Rowbotham s connection

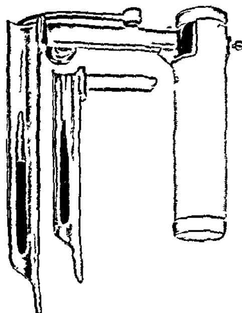


FIG 163A Magill's laryngoscope original pattern with detachable lamp carrier and interchangeable adult and child size stainless steel blades

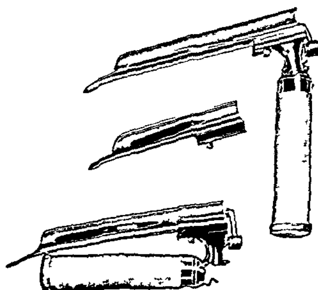


FIG 163B Magill's laryngoscope folding pattern

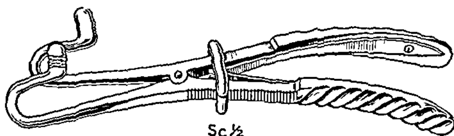


FIG 171 Fergusson s mouth gag
This is available in adult and child sizes

MOUTH PROPS These serve several purposes but apart from their use in dental operations and other operations requiring an open mouth they may be used to keep the jaws apart and so prevent an anæsthetized patient from biting and occluding the artificial airway or intratracheal tube The Devonshire dental prop is the least traumatic of these instruments

ARTIFICIAL AIRWAY This is a most important and constantly used piece of equipment It is designed for use in the unconscious patient (Fig 205) with relaxed pharyngeal and tongue muscles when the tongue tends to fall against the posterior pharyngeal wall and occlude the natural airway (Fig 202) It is curved, so that on insertion it follows the curve of the tongue and separates that organ from the posterior pharyngeal wall

Artificial airways are supplied in many types and vary in size for use in different sized patients

The popular types are the Guedel (Fig 172) and the Hewitt (Fig 173) which are of rubber with a detachable metal mouthpiece and the Mona Roberts and the Waters which are all metal

They may all be sterilized by boiling



FIG 172 Guedel s airway
Available in three sizes 1 2 and 3 (the largest)



FIG 173 Hewitt s airway
Available in four sizes 1 2 3 and 4 (the largest)

SUCTION APPARATUS As suction may be urgently required should there be any fluid or vomited matter causing obstruction to the airway anæsthetic and operating rooms are provided with suckers for use by the anæsthetist, in addition to the apparatus for use by the surgical team

Sucker heads such as the Yankauer type, are supplied together

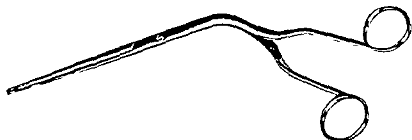


FIG 168 Magill s intubation forceps
These are used to guide endotracheal tubes into the larynx and are available in adult and child sizes

Is is thus obvious that those gags designed to be set between the molar teeth are the most suitable for this purpose Gags such as Ackland s (Fig 169) Mason s (Fig 170) Fergusson s (Fig 171) and Doyen s are of this type and of these, the first three named are preferable as they have parallel jaws, which make them easier to insert in the small space between clenched teeth *The blades should be* covered with a thin piece of rubber, to avoid damage to the teeth

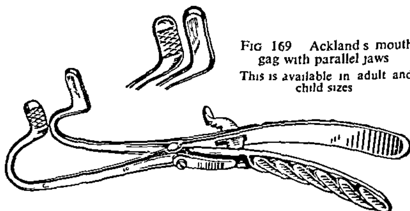


FIG 169 Ackland s mouth gag with parallel jaws
This is available in adult and child sizes

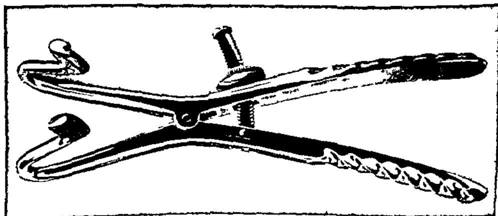


FIG 170 Mason s mouth gag
This is available in two sizes

size that the lumen of an ordinary rubber tube would be readily occluded by outside pressure causing dangerous obstruction to the airway The armoured tubes prevent this occlusion Metal introducers are provided for use with armoured tubes

(b) *Carlen s tubes* which are designed for anæsthesia using one lung only, whilst operation is being performed upon the other

(c) *James tubes* which are short, right angled cuffed, rubber tubes for use in a patient after tracheostomy and in whom the protective cough and swallowing reflexes are absent

Magill s tubes may be sterilized (a) by boiling for no longer than two minutes the connexion being first removed, or (b) by washing in Cetavlon followed by immersion for two to three hours in 1 in 1,000 biniodide of mercury These tubes must be thoroughly washed after removal from this solution

Metal connexions of various types are supplied for connecting the Magill tube to the source of the anæsthetic The ones in common use are those of Magill (Fig 165), Cobb (Fig 166), Rowbotham (Fig 167) Renton and Ayre They are available in several sizes to fit the Magill endotracheal tubes

Magill s Intubating Forceps These forceps (Fig 168) should be available with large and small blade tips

Lubricants for Endotrachlal Tubes All lubricants provided for these tubes should have a water soluble base to ensure easy cleaning and prevention of destruction of the rubber

Cleaning Brushes for Endotracheal Tubes After use Magill s endotracheal tubes should be immediately thoroughly washed and cleaned with a special brush (similar to a fine bottle brush) of appropriate size

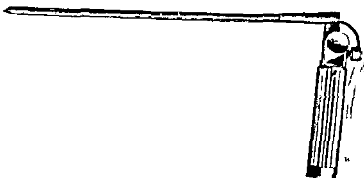


Fig 174 Magill s emergency bronchoscope

This is available in sizes 5 8 and 11 mms and it has a folding handle with automatic lighting

with firm No 5 and No 10 rubber catheters Connexions of suitable size (preferably of glass) which fit both the catheter and the suction tubing are also necessary

LARYNGOSCOPE This instrument (Figs 162 and 163) is used (a) to expose the larynx and the pharyngeal opening of the œsophagus and (b) for the passage of an endotracheal tube by direct vision

Most types in general use have detachable blades for ease of cleaning and sterilization and also in order that one handle may carry several sizes of blades All laryngoscopes used by anæsthetists have the batteries in the handle of the instrument

The two common varieties of laryngoscope are folding and non folding

When one of the folding variety is fully extended it becomes L shaped and the lamp is switched on by the opening of the instrument The Macintosh and the Magill Guedel laryngoscopes are of this type and are supplied with three sizes of curved blade and three sizes of straight blade

Non folding laryngoscopes may be U shaped as in the Magill type or L shaped as in the Flagg type They are each supplied with three straight blades

A very small laryngoscope such as the Shadwell, is necessary for use in the tiny baby

ENDOTRACHEAL TUBES These tubes are passed by the nose (nasal intubation) or by the mouth (oral intubation) through the larynx to the trachea They provide an unobstructed artificial airway when the natural airway is likely to be obstructed during operation (a) by posture of the patient or (b) by fluid or foreign matter of any kind in the pharynx They are also used whenever sterile drapes cover the head

Endotracheal tubes must also be used whenever an anæsthetic technique involving inflation of the lungs is to be employed

The Magill endotracheal tubes are made of rubber and are of two types —

(a) *Plain* These are available for oral use in sizes 00 to 10 and as thinner walled tubes for nasal use in sizes 2 to 8

(b) *Cuffed* (Fig 164) Sizes 3 to 10 Cuffed tubes are designed in such a way that on correct inflation of the cuff not only is an airtight circuit provided to and from the source of the anæsthetic or oxygen but fluids and foreign matter are prevented from reaching the lower trachea and lungs

Other types of endotracheal tubes in use are —

(a) *Armoured tubes* which are made of latex rubber with an inner metal spiral for reinforcement They are supplied in sizes 00 to 10 Sizes 00 to 4 are employed for small infants In these patients the tubes used must be of such a small

B Sterile set of instruments (Fig 175) for venesection containing —
  Scalpel Skin retractors Needle holder Cannulae
  Fine pointed scissors,
  Toothed and non toothed dissecting forceps
  Artery forceps both straight and curved,
  MacCormick s dissector or aneurysm needle
  Swabs both gauze and wool,
  Fine cutting needles for skin sutures
  Suture materials for ligation of the vein and for the skin suture

C Stands for hanging the bottles

D Julian Smith s pump for blood acceleration (Fig 176) (Because



Fig 176 Julian Smith s pump
In this case the handle of the pump will be moved in an anti-clockwise direction and thus the blood will be forced along the tubing and into the vein

of the risk of air embolism on no account must oxygen or other gas from a cylinder ever be used as a means of supplying positive pressure to increase the speed of a transfusion)

E Supply of serum albumin in bottles containing 100 ml

F Supply of intravenous fluids of many types —
  Dextrose 10 per cent in distilled water
  Dextrose 5 per cent in distilled water
  Dextrose 5 per cent in Normal saline
  Dextrose 4 per cent in 1/5 Normal saline
  Normal saline
  Darrow s solution
  Sucrose 50 per cent

EMERGENCY BRONCHOSCOPE Magill's emergency bronchoscope (Fig 174) is similar in principle to the folding laryngoscope and is available with blades of three sizes for adults, small adults and children

iii Equipment used for Blood Transfusion and for the Intravenous Infusion of Serum Albumin, Serum, Glucose, Saline, etc

A Sterile giving sets for blood transfusion containing —

Needle (at least 19 gauge) for puncturing the bung of the reservoir of blood,
Air vent needle,
Rubber or plastic tubing with filter and drip chambers,
Tubing clamp or regulator for the drip,
Needles for venepuncture (17, 18 and 19 gauge),
Metal, plastic, or glass cannulæ,
Spare sterile air vent needles and filter chambers

Disposable transfusion sets are now in common use also (Chapter 7)

Sterile giving sets for the administration of continuous intravenous fluids are similar to the above sets for blood transfusion, but usually they are without a filter chamber

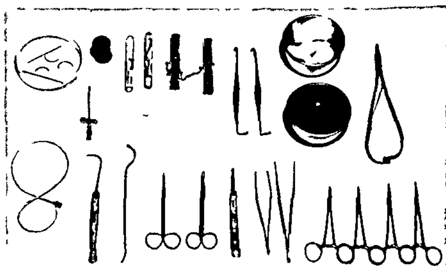


FIG 175 Instruments for venesection

These are from left to right in the upper row —Cutting edge needles cannula suture material for the skin tubes of catgut breakers for the tubes of catgut Kilner s skin retractors bowl of sterile swabs bowl of skin lotion and needle holder In the lower row from left to right there are — Polythene tubing and needle to act as a connexion aneurysm needle MacCormick s dissector straight scissors curved scissors scalpel and blade toothed and non toothed dissecting forceps and straight and curved artery forceps

B Sterile set of instruments (Fig 175) for venesection containing —
  Scalpel, Skin retractors Needle holder Cannulae
  Fine pointed scissors,
  Toothed and non toothed dissecting forceps
  Artery forceps both straight and curved,
  MacCormick s dissector or aneurysm needle,
  Swabs both gauze and wool
  Fine cutting needles for skin sutures
  Suture materials for ligation of the vein and for the skin suture

C Stands for hanging the bottles

D Julian Smith s pump for blood acceleration (Fig 176) (Because



Fig 176 Julian Smith s pump
In this case the handle of the pump will be moved in an anti-clockwise direction and thus the blood will be *forced along the tubing and into* the vein

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E Supply of serum albumin in bottles containing 100 ml

F Supply of intravenous fluids of many types —
  Dextrose 10 per cent in distilled water
  Dextrose 5 per cent in distilled water
  Dextrose 5 per cent in Normal saline
  Dextrose 4 per cent in 1/5 Normal saline
  Normal saline
  Darrow s solution
  Sucrose 50 per cent

G Ampoules of procaine hydrochloride (1 per cent) 2 ml syringe and 24 gauge needles

iv Equipment for Observation of the Patient during Operation

Stop watch
Sphygmomanometers
Stethoscopes
Thermometers (oral rectal and œsophageal)
Carbon dioxide analyser for attachment to the gas machine,

Cardioscope for continuous electrocardiography or a cardiac monitor for registering the cardiac impulse

v Equipment and Drugs for Anæsthetic Emergencies

Every operating theatre and recovery room should be equipped with the following sets ready always for immediate use They must be checked daily and every member of the staff should be well acquainted with their place of storage

A CARDIAC ARREST KIT For ease of recognition this should be wrapped in a *scarlet envelope* It should contain —

Two scalpels
Scissors
A rib spreader
Toothed dissecting forceps
Two 20 ml and two 2 ml syringes
Two 3 inch and two 1 5 inch 21 gauge needles (these syringes and needles to be of similar fitting Record or Luer Lok)
Four artery forceps
Suture and ligature material
Suture needles
Needle holder

Duplication of the contents of this set is desirable as articles are apt to be dropped or broken at critical times

B EMERGENCY LUNG INFLATION EQUIPMENT —

Sucker head and catheter suckers
Three airways sizes 1 2 and 3
Bag and face mask attachment for oxygen cylinder,
Laryngoscope (checked daily)
Emergency bronchoscope (checked daily)
Magill tubes and connexions

This must be stored with the Cardiac Arrest Kit

C EMERGENCY DRUG SET The drugs supplied in ampoules should be stored in small transparent containers with the name of the drug painted on the container and they should be arranged in the following groups —

Group 1, for use in cases of cardiac arrest —
Adrenalin 1 in 1,000 1 ml,
Calcium chloride 10 per cent 5 ml,
Noradrenaline (Levophed) 0 1 and 0 2 per cent 2 and 4 ml
Potassium chloride 4 per cent, 5 ml,
Procaine hydrochloride 1 per cent (without adrenalin), and
Procaine amide hydrochloride (Pronestyl and Procardyl) 10 per cent, 10 ml

Group 2, for use in cases of drug overdosage or sensitivity —
Lethidrone (n allyl morphine),* 10 mg in 1 ml,
Daptazole (Amiphenazole) 30 mg
Megimide (NP13 or Bemegride)** 0 5 per cent, 100 ml
Methylene blue 1 per cent 10 ml
Nikethamide (Coramine), 250 mg in 1 ml, and
Sodium thiopentone (Pentothal) 0 5 and 1 gramme

* Reverses pethedine and morphine derivatives
** Used in the termination of barbiturate anæsthesia

Group 3 for use when intra arterial injection of sodium thiopentone (Pentothal) is accidentally made —

Heparin 5,000 units in 1 ml
Hyaluronidase (Hyalase) 1,000 units in 1 ml,
Lignocaine hydrochloride (Xylocaine) 2 per cent 50 ml
Papaverine hydrochloride 130 mg in 10 ml and
Priscol 10 mg in 1 ml

Group 4 for raising the blood pressure and for use as heart stimulants —

Digoxin 0 5 mg in 1 ml
Ephedrine hydrochloride gr $\frac{1}{2}$ and $\frac{3}{4}$ in 1 ml
Methedrine 30 mg in 1 5 ml
Neo Synephrine 10 mg in 1 ml
Ouabaine 0 25 mg in 1 ml
Solu Cortef 100 mg in 2 ml and
Levophed Special Solution 0 2 mg in 2 ml

D TRACHEOSTOMY SET (See Chapter 19)

E SUCKER This has already been mentioned but it is so important that it is repeated It should be connected and ready for immediate use

F CARDIAC DEFIBRILLATOR AND PACEMAKER There are many types of this machine manufactured and many more being designed so that any detailed description of one particular make becomes merely confusing

The machine is constructed so that one electric shock or a series of shocks of varying degrees of intensity may be delivered directly

to the heart which is fibrillating or at a standstill (see the section on 'Cardiac Arrest')

Whatever type of defibrillator is supplied to the Anæsthetic Department, it should be obligatory that a simple, clearly printed list of instructions for its use is attached to the machine by a chain

vi Equipment for Continuous Artificial Respiration

Detailed description and discussion of mechanical respirators is felt to be out of place in this book Suffice it to say that these machines are designed for use when rhythmical manual lung inflation is impracticable that is, during prolonged periods of respiratory depression or during anæsthesia when the anæsthetist must have free hands for other duties

The use of tank or cuirass respirators (which produce gaseous exchange in the lungs by negative pressure on the chest wall) has now been largely replaced by the use of positive pressure inflation machines (the lungs are directly inflated with air or gas under pressure by the machine)

The mechanical respirators most often used in Australia are the Aintree the Bennett the Beaver and the Harrington James

2 EQUIPMENT TO BE PREPARED FOR ALL ANÆSTHETICS

These articles (Fig 161) should be set out for every type of anæsthetic general, spinal regional etc They are to be considered as safeguards in the event of sudden collapse which may occur during any operation Cardiac arrest may take place even when the patient has not had a general anæsthetic and this equipment may be needed urgently

(i) SUCKER This should be tested before the anæsthetic is commenced to make sure that the only attention necessary if it is needed is simply switching or turning it on It should be provided with both an ordinary sucker head and firm No 5 and No 10 rubber catheters with suitable connexions fitting both the catheters and the sucker tubing

(ii) LARYNGOSCOPE (Figs 162 and 163) This should also be tested before the anæsthetic commences The globe should be tightened before testing as this is apt to become loose on the thread If the laryngoscope is of the type with detachable blades it should be checked to ensure that the blade is firmly attached and that it will not pull off when in position in the pharynx

(iii) ENDOTRACHEAL TUBES (Fig 164) In general for adult patients plain tubes sizes 5 to 9 and cuffed tubes sizes 6 to 10 should be set out together with the appropriately sized metal connexions (Figs 165 166 and 167) for attachment to the oxygen supply or gas machine

If the patient is a child under the age of 11 years, sizes 00 to 5 plain tubes will be suitable, but children 11 years and over (unless small for their age) require the adult range of tubes

All the tubes should be firm and free of kinked or softened areas of rubber

The cuffs of the cuffed tubes should be inflated and tested

(iv) 10 ml Record fitting syringe for cuff inflation and clips for securing the pilot tube of the cuff
(v) Lubricant for endotracheal tubes
(vi) Magill s intubating forceps (Fig 168)
(vii) Oxygen supply This is in the form of a cylinder with pressure gauge and flowmeter a gas machine or a piped supply Whatever the type supplied it must be tested and if the supply is low a report must be made to the anæs thetist
(viii) Some means of lung inflation This may be either (a) a simple bag and mask attachment for the oxygen cylinder or piped supply or (b) the gas machine
(ix) Mouth gag (Figs 169 170 and 171)
(x) Airways (Figs 172 and 173) All sizes of airway should be set out

The connexion between the rubber and metals parts of the Guedel and Hewitt airways should be tested Airways with loose connexions should not be used as the two sections are apt to become detached during anæsthesia

(xi) Emergency bronchoscope (Fig 174) This must be tested in the same way as the laryngoscope
(xii) Adhesive tape and scissors

3 EQUIPMENT REQUIRED FOR THE PARTICULAR ANÆSTHETIC TO BE GIVEN

INHALATION ANÆSTHESIA

(A) Ether and Ethyl Chloride Anæsthesia Nurses and others should always remember that these substances are very inflammable and explosive and before setting up for these anæsthetics all possible sources of ignition should be removed from the theatre Electric radiators should be turned off and preferably taken outside the operating room so that they will not be inadvertently switched on by another person

Electric fans (unless of a special non sparking type) must be turned off and are also better removed All the power points in the room should be checked to make certain that they are switched off

Equipment For All Anæsthetics is required (see Section 2)
In addition —

(i) Ether

(ii) Ethyl chloride
(iii) Eight ounce bottle with a drip cork (Bellamy Gardner s drip cork is the most commonly used, Fig 177)
(iv) Bellamy Gardner s wire masks, adult and child sizes (Fig 178)

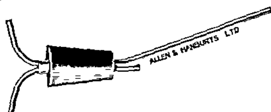


FIG 177 Bellamy Gardner s drip cork

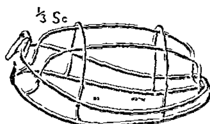


FIG 178 Bellamy Gardner s wire mask for open ether anæsthesia This is available in adult and child sizes

(v) Long layered gauze rolls for making masks These rolls should be 6 inches wide and 2 yards long and should be composed of six layers of gauze stitched in rows to hold them together

If the long rolls are not used, a thick huckaback towel 1 yard long folded lengthways four times or a terry towel 1 yard long folded lengthways twice may be substituted

(vi) Towel clips or safety pins to attach the roll to the mask
(vii) Gauze or lint face pieces to prevent liquid ether or strong vapour from burning the face or eyes If made of stitched gauze they should be thick about 7 inches square, with a hole 3 inches in diameter cut in the centre for the nose and mouth
(viii) Ether vaporizer All models consist basically of a current of air passing over or through liquid ether and carrying the resultant ether vapour to the patient through rubber tubing A source of heat for increased rate of vaporization is usually incorporated in the machine The machine commonly in use in Australia is the drip feed chamber type (Clements) with either a warm water bath or a small element for heating

The ether vaporizer should be checked to make sure that it contains ether but that the tank is not more than two

thirds full Space must be allowed for vaporization The heat source should also be checked to make sure that the ether will only be warmed, not overheated The machine should be switched on to check that the rubber tubes, (a) bringing in the current of air, and (b) leading to the patient, are correctly connected to the machine

(B) **Chloroform Anæsthesia** Equipment For All Anæsthetics (Section 2)

In addition —

Schimmelbusch s mask, thick lint square (double thickness, 9 inches square) face pieces as for ether anæsthesia bottle and dripper cork, and chloroform

Both ether and chloroform tend to decompose if exposed to light

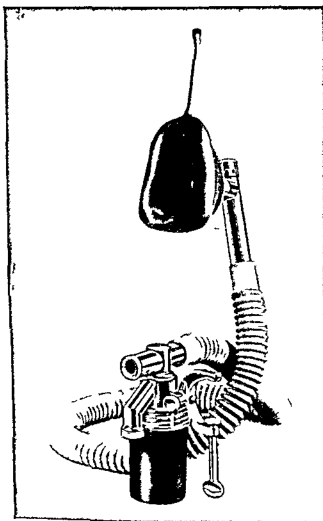


FIG 179 Freedman s trilene inhaler

or heat They are therefore supplied in brown glass bottles which should be stored in a cool, dark cupboard well away from any flame or heat

(C) **Trilene (Trichlorethylene) Anæsthesia** 'Equipment For All Anæsthetics (Section 2)

In addition —

Trilene Trilene is usually administered with the gas machine as anæsthesia for surgical operations but special machines may be

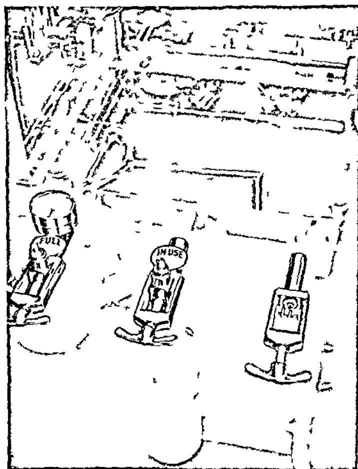


FIG 180 The side of a gas machine showing the Pin Index safety system

The valve of the gas cylinder fits into the front assembly The cylinders containing gases to be used on anæsthetic machines now have a pair of holes near the outlet orifice The arrangement of these holes differs for each type of gas As there are corresponding pins on the sockets of the anæsthetic machine it is not possible to connect a cylinder in its wrong place *e g* it is no longer possible to connect a cylinder containing carbon dioxide or other gas to the yoke intended for oxygen (see Fig 181) This is called the Pin Index safety system but it does not replace other means of identifying the gas cylinders In addition the cylinders are clearly labelled and there is a standard colour for each type of cylinder A cylinder containing oxygen is denoted by a black cylinder with a white top nitrous oxide (N_2O) by a blue cylinder carbon dioxide (CO_2) by a green cylinder and so on

provided particularly in Obstetrics Departments The Emotril and Tecota Mark 6 machines are used for the continuous administration of Trilene whilst the Cyprane and Freedman inhalers are used for self administration If the gas machine is used the soda lime should be excluded from the anæsthetic circuit or it should be removed

Pethidine hydrochloride is sometimes required by the anæsthetist during these anæsthetics in order to reduce the respiratory rate which may increase during Trilene administration

(D) Gas Anæsthesia Nitrous Oxide and Oxygen, Cyclopropane
' Equipment For All Anæsthetics (Section 2)
In addition —

Gas Machine Nitrous oxide and cyclopropane are administered with some form of gas machine, and the one in commonest use in Australia is the Coxeter Boyle or Coxeter King machine Heidbrink and McKesson machines may be supplied Ether chloroform Trilene, and Fluothane are also given with these machines The gas machine must be carefully checked before being declared ready for use

The soda lime which absorbs the exhaled carbon dioxide (CO_2) may be of the Indicator Type that is an alteration in colour will show that it needs changing If plain soda lime is in use a notebook indicating the hours of use should be kept by the anæsthetists, and, when four to six hours are recorded it should be changed before another anæsthetic is commenced

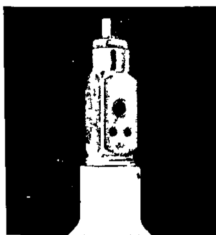


FIG 181 Showing the Pin Index safety system

The attachment of the cylinders should also be checked Asphyxiation of the patient has occurred following the erroneous attachment of the nitrous oxide cylinder in the oxygen yoke This hazard has now been eliminated in most parts of the world by the introduction of the Pin Index (Figs 180 and 181) Arrangements of metal pins on

the machine yokes will only fit the corresponding holes in the appropriate gas cylinders and it is now impossible to attach the wrong cylinder to the yoke and have it deliver gas The level of gases in the cylinders should be checked and, if low a report made to the anæsthetist There must always be at least one full oxygen cylinder on the machine—a tested one and not merely a fresh cylinder brought in from the store Anoxia can occur very quickly if one cylinder becomes exhausted and the new one is then found to be empty

The tubing and masks of the gas machine should be cleaned after use by washing through with soapy water, and they may be sterilized by —

(i) exposing to paraform tablets in a closed jar for two days
(ii) immersing in a 1 in 1,000 solution of biniodide of mercury for two hours,
(iii) autoclaving

Whenever any antiseptic has come in contact with the tubing or mask it must be thoroughly washed out with water

It is especially important that masks and tubings are sterilized after use on a patient suffering from tuberculosis

Waters Canister Four sizes of this canister are necessary with mask mounts intratracheal fittings a tube for attachment to the oxygen cylinder and re breathing bags in two sizes It is used for attachment to gas machines or with oxygen alone (Fig 182)

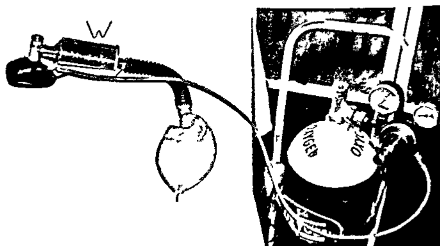


FIG 182 Waters canister (W) connected to a face mask bag and oxygen cylinder

The tubing bringing the oxygen to the mask is attached to the reducing valve Above this valve the pressure gauge and the flowmeter are visible

	Length	Diameter	Re breathing Bag
Infant's size	5 5 cms	5 cms	500 ml
Child s size	8 cms	6 cms	2 litre
Medium size	12 cms	7 cms	2 litre
Adult size	13 cms	8 cms	2 litre

(E) Vinesthene Anæsthesia   Equipment For All Anæsthetics (Section 2) The Goldman inhaler, or a modification of it, is used for this anæsthetic

(F) Fluothane Anæsthesia   Equipment For All Anæsthetics" (Section 2)

In addition —

Fluothane

The Fluotec attachment (Fig 183) for the Coxeter King or other gas machines

Ephedrine hydrochloride, Methedrine or Neo Synephrine may be needed as the blood pressure tends to fall during the administration of Fluothane

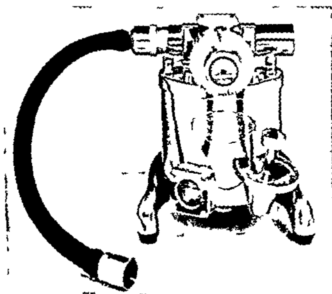


Fig 183   Fluotec attachment

INTRAVENOUS ANÆSTHESIA INCLUDING RELAXANTS

Equipment For All Anæsthetics (Section 2)

In addition —

(i) Arm board
(ii) Small plastic-covered pillow and bandage for fastening the arm to the board,
(iii) Tourniquet
(iv) Adhesive strapping and scissors

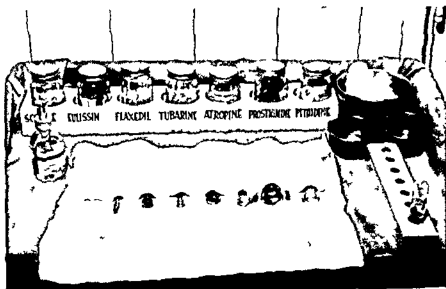


FIG 184 Pentothal tray *i e* the set up for intravenous anæsthesia

(v) A tray or trolley (Fig 184) containing —

(a) Syringes (Luer or Record) two 2 ml, one 5 ml and one 10 ml

Two 21 gauge 1½ inch needles (Luer or Record),

Mitchell s needle (Figs 185 and 186)

Mixing cannula for mixing the sodium thiopentone (Pentothal)

Occasionally the anæsthetist will also require Gordh needles (Fig 187), syringe and needle adapters (Record to Luer and Luer to Record) or fine rubber tubing with a glass connexion and a needle adapter for attaching the syringe at a distance

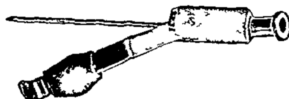


FIG 185 Mitchell s needle with the spring closed and with it swivelled back

This needle permits repeated intravenous injections without taking the needle out of the vein between each injection The centimetre beyond the opening in the side wall of the needle is solid *When the needle is in* position the light metal spring and rubber pad presses on the skin and temporarily blocks the opening of the needle thus it effectively prevents any reflux of blood into the needle

These articles in this list (a) are best contained in an autoclaved pack, a fresh pack being opened for each anæsthetic The needles should be very sharp and have short bevels and they must have Record or Luer fittings to match the syringes

(b) Sterile gauze swabs
(c) Small sterile bowl of skin lotion
(d) Small sterile bowl of distilled water



FIG 186 Mitchell s needle in a vein and with the spring closed

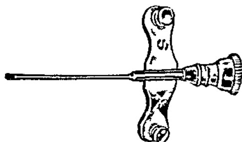


FIG 187 Gordh s needle
The outer end of this needle is covered with a thin self sealing rubber diaphragm through which repeated intravenous injections may be given

(e) Bowl for dirty syringes and needles
(f) Bowl for used ampoules swabs etc
(g) Ampoules of —

Sodium thiopentone (Pentothal) 0 5 and 1 gramme
Viadril if this is to be used
Pethidine hydrochloride 50 and 100 mg
d Tubocurarine chloride (Tubarine) 15 and 20 mg in 1 5 and 2 ml
Gallamine triethiodide (Flaxedil) 80 and 120 mg in 2 and 3 ml

Suxamethonium chloride (Scoline) 100 mg in 2 ml,
Decamethonium diiodide (Eulissin) 5 mg in 2 5 ml
Atropine sulphate, gr 1/100 and 1/50 in 1 ml
Prostigmin, 2 5 mg in 1 ml, and
Distilled water, 5 and 10 ml

(h) Files for opening ampoules

SPINAL EPIDURAL AND CAUDAL ANÆSTHESIA

Equipment For All Anæsthetics' (Section 2) is definitely required

The drugs used for *spinal anæsthesia* are light Nupercaine (1 in 1 500) in 20 ml ampoules, heavy Nupercaine (1 in 200) in 3 ml ampoules light amethocaine hydrochloride (Decicain) (1 in 1 000) (Light Spinal D) in 20 ml ampoules and heavy amethocaine hydro chloride (Decicain) (1 in 100) (Heavy Spinal D) in 3 ml ampoules

In addition —
Sterile gown and gloves for the anæsthetist
Sterile bowl for skin lotion
Sterile gauze swabs and swab holding forceps
Shoulder rests for the operating table for use when tilting is required

All equipment for these anæsthetics *must* be *autoclaved* and the procedure *must be carried out with scrupulous asepsis* After use the syringes needles and stilettes must be carefully cleaned and dried and they should not be used for any other purpose If any blood or other material is allowed to dry in the needle or syringe it may produce irritation of the spinal cord when they are next used If the needle is permitted to rust, part may break off in the tissues and be very difficult to recover

Autoclaved pack containing —
- 5 ml syringe (Luer Lok)
- Two 2 ml syringes (Luer Lok)
- Two 21 gauge Luer Lok needles
- 24 gauge Luer Lok hypodermic needle
- Two special spinal puncture needles Luer Lok 3 to 3½ inches long 18 to 21 gauge and each fitted with a stilette Care must be taken before autoclaving to make sure that the stilette fits the needle exactly One which is too long may either cause the anæsthetic solution to be deposited outside the dura mater or it may tear the dura mater during spinal puncture
- A special introducer for the spinal needle such as Sise s pattern (Fig 188)
- Files for opening ampoules
- Ampoules of anæsthetic solutions for spinal anæsthesia, as described above
- Ampoules of vasopressor drugs such as ephedrine hydrochloride Methedrine and Neo Synephrine for the maintenance of the blood pressure

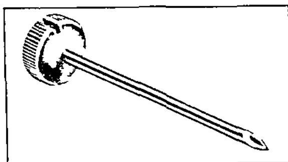


FIG 188 Sise s spinal needle introducer
This acts as a guide through the skin ligaments and fascia and along its lumen a fine spinal needle may be inserted into the dura

Ampoules of 2 per cent procaine hydrochloride for anæsthetizing the skin at the site of puncture

All these ampoules needles and syringes must be autoclaved as contaminated material injected into the spinal canal will lead to meningitis The ampoules should *never* be soaked in antiseptic solutions or exposed to formalin vapour If even a minute crack is present in these ampoules the antiseptic may seep into the solution



FULL SIZE

FIG 189 Rowbotham s guide
This instrument is used in the same manner as Sise s introducer

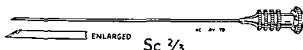


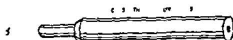
FIG 190 Wilfred Harris spinal needle 20 gauge and 3 inches long

and when injected it will cause destruction of the delicate nerve tissue in the spinal canal with resultant paresis or paralysis

A sphygmomanometer stethoscope and the Equipment for Intra venous Anæsthesia as described above should also be available

For *epidural anæsthesia* ampoules of procaine hydrochloride 3 per cent lignocaine hydrochloride (Xylocaine) 1 5 per cent adrenalin 1 in 1 000 and a Rowbotham guide (Fig 189) Wilfred Harris needle (Fig 190) with Odom indicator (Fig 191) or Macintosh needle are added to the above autoclaved pack

For *caudal analgesia* Metycaine 1 5 per cent and Nupercaine 1 in 600 are used The Dawkins needle cannula is added to the auto claved pack or, if the caudal analgesia is to be continuous a special



FULL SIZE

FIG 191 Odom s indicator

This instrument which is made of glass is inserted into the end of a spinal needle while it is being introduced into the epidural space The needle and the introducer are filled with Normal saline and when the epidural space is entered by the point of the needle the meniscus of the fluid in the introducer moves inwards because of the negative pressure

malleable needle which is used for this can be left *in situ* whilst the patient is moved

LOCAL ANÆSTHESIA

The solutions used are procaine hydrochloride 0 5 1 and 2 per cent with or without adrenaline hydrochloride added, lignocaine hydro chloride (Xylocaine) 0 5 to 2 per cent solutions and perhaps Efocaine

' Equipment For All Anæsthetics (Section 2) is again a necessity In addition —

Trolley containing the following equipment —

(a) Unsterile —

Eyepiece for covering the eyes and some means of fixing it
Soft gauze rolls or special straps for fastening the limbs,
Straps for the thighs
Cotton wool plugs for the ears
Arm board pillow bandage, and tourniquet
Strapping and scissors

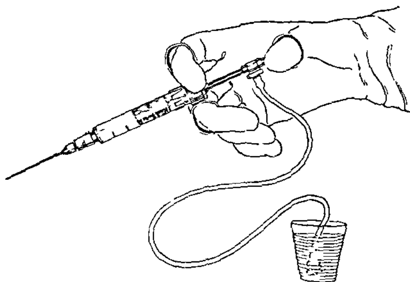


FIG 192 Pitkin s syringe for the injection of a local anæsthetic agent The rubber tube leads to a glass of solution and by means of a valve the syringe refills when the plunger is withdrawn

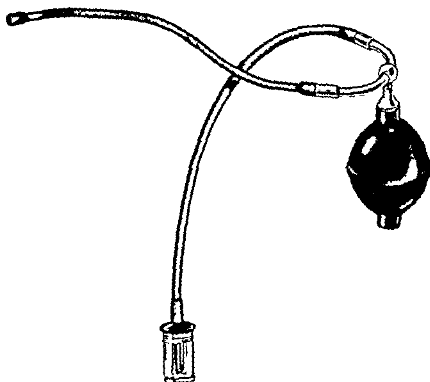


FIG 193 *Macintosh's throat spray*

(b) Sterile —

Measuring vessel for the local anæsthetic solution
Two graduated medicine glasses
Bowl of skin lotion
Bowl of gauze swabs
Swab holders
Two large and two small drapes for the patient,
Gown and gloves for the anæsthetist

An autoclaved pack containing —

Labat's or Pitkin's syringe (Fig 192) and flexible needles of appropriate size varying from 2 to 12 cms in length

One 2 ml syringe graduated in minims and two 24 gauge hypodermic needles

Local anæsthetic solutions Xylocaine 0 5 to 2 per cent and procaine hydrochloride (Novocain) 0 5 and 2 per cent

Adrenalin 1 in 1 000 for addition to the anæsthetic solutions
Morphine sulphate ampoules containing gr 1/8 and 1/6
Pethidine hydrochloride ampoules containing 50 and 100 mg and

Sodium thiopentone (Pentothal) ampoules containing 0 5 and 1 gramme with ampoules of distilled water and sterile pack for administration

TOPICAL ANÆSTHESIA

The solutions used are cocaine hydrochloride 2 to 20 per cent, Decicain (amethocaine hydrochloride) 2 per cent, and lignocaine hydrochloride (Xylocaine) 4 per cent

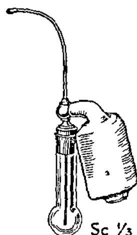


FIG 194 Magill s throat spray

Equipment For All Anæsthetics (Section 2)
In addition —
Tray containing —
- Throat sprays, de Vilbiss (Fig 27) Mac intosh (Fig 193) and Magill (Fig 194)
- Anæsthetic lubricants in collapsible tubes,
- Anæsthetic lozenges (Decicain gr 1)
- Decicain (amethocaine hydrochloride) solution 2 per cent,
- Adrenaline hydrochloride 1 in 1,000 1 ml ampoules,
- Syringes 2 and 5 ml,
- 18 gauge 2 inch needle
- Pharyngeal applicators
- Tongue depressor
- Gauze and wool swabs

Medicine glass for mixing anæsthetic and adrenaline solutions
Half inch gauze strips or rolls
Equipment for Intravenous Anæsthesia '
Laryngeal mirror
Head mirror
Laryngoscope

INTRATRACHEAL ANÆSTHESIA

Equipment For All Anæsthetics (Section 2)

It will be noted that this included most of the equipment for intra tracheal anæsthesia Carlen s tubes should also be available for endobronchial anæsthetics

In addition —

Anæsthetic equipment for the agent to be used for induction of anæsthesia

A source of anæsthetic for maintenance when intubation has been performed

Head harness or bandage for fixing the source of anæsthetic to the head of the patient

Small sponge rubber or plastic pad to prevent pressure on the forehead or face

Syringe for inflation of the cuff and a clip whenever a cuffed tube is to be used

Adhesive tape and scissors

RECTAL ANÆSTHESIA

Equipment For All Anæsthetics (Section 2)

In addition —

A For sodium thiopentone (Pentothal) —

5 per cent solution of Pentothal in distilled water The dose is 20 ml per 50 lb of body weight with a maximum dose for children of 30 ml

Catheter and funnel

B For bromethol (Avertin) —

2½ per cent solution of Avertin in distilled water at 40° Cent (104 Fahr) The dose is 80 to 120 mg per kilogram of body weight the smaller dose being used in elderly, feeble or obese patients and up to the larger dose being used in feverish patients or those in much pain

Chart showing the quantities of Avertin and distilled water required according to the weights of the patients

Glass stirring rod

Thermometer

Thermos flask If the solution cools the Avertin will crystallize out of solution whereas at a higher temperature than 40 Cent (104 Fahr) the Avertin decomposes to form very irritant and very toxic substances The solution of Avertin should not be prepared more than an hour or so before use even if the correct temperature is maintained in the interval

0 1 per cent Congo Red solution for testing the Avertin

In the APPENDIX details are given of the various systems of weights and measures and the reader should frequently refer to them

More and more hospitals are adopting the Metric System and it is therefore most important to remember the relationship between grains and grammes for example that 10 8 milligrams (mg) equals 1/6 of a grain (gr)

10 8 mg = gr 1/6

Sodium thiopentone (Pentothal), ampoules containing 0 5 and 1 gramme, with ampoules of distilled water and sterile pack for administration

TOPICAL ANÆSTHESIA

The solutions used are cocaine hydrochloride 2 to 20 per cent Decicain (amethocaine hydrochloride) 2 per cent and lignocaine hydrochloride (Xylocaine) 4 per cent

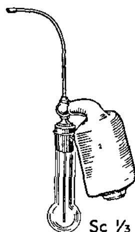


FIG 194 Magill s throat spray

Equipment For All Anæsthetics (Section 2)
In addition —
Tray containing —
Throat sprays, de Vilbiss (Fig 27) Mac intosh (Fig 193) and Magill (Fig 194),
Anæsthetic lubricants in collapsible tubes
Anæsthetic lozenges (Decicain gr i),
Decicain (amethocaine hydrochloride) solution 2 per cent
Adrenaline hydrochloride 1 in 1 000 1 ml ampoules
Syringes, 2 and 5 ml
18 gauge 2 inch needle
Pharyngeal applicators,
Tongue depressor
Gauze and wool swabs
Medicine glass for mixing anæsthetic and adrenaline solutions
Half inch gauze strips or rolls
Equipment for Intravenous Anæsthesia ,
Laryngeal mirror
Head mirror
Laryngoscope

INTRATRACHEAL ANÆSTHESIA

Equipment For All Anæsthetics (Section 2)

It will be noted that this included most of the equipment for intra tracheal anæsthesia Carlen s tubes should also be available for endobronchial anæsthetics

In addition —

Anæsthetic equipment for the agent to be used for induction of inæsthesia

A source of anæsthetic for maintenance when intubation has been performed

Head harness or bandage for fixing the source of anæsthetic to the head of the patient

Small sponge rubber or plastic pad to prevent pressure on the forehead or face

in the pre operative management of the patient If possible the patient s place in the ward is arranged so that long morbid pre operative conversations with others are avoided A few light duties will distract his mind from the coming ordeal, and this is especially important in cases admitted for various tests several days before operation Above all an interested and unhurried attitude should be maintained by the admitting nurse, so that the patient may feel that his welfare is of personal concern to her Thus she prepares for the anæsthetist a comparatively calm patient whose fears have been allayed and who has gained confidence in all concerned The patient not so prepared is at a great disadvantage He is fearful nervous and excited, and such a state requires an increased amount of anæsthetic to overcome it and worse still is marked by such increased instability of all reflexes as leads to a greater likelihood of shock respiratory arrest or cardiac arrest

CASES REQUIRING EARLY ADMISSION AND SPECIAL NURSING CARE

1 Patients with delayed emptying of the stomach
2 Patients with diabetes mellitus
3 Patients known to have cardiac insufficiency
4 Patients for thyroidectomy who have suffered from thyreo toxicosis
5 Sufferers from severe chronic bronchitis or from bronchiectasis Daily postural drainage with careful records of the amount and type of sputum is necessary for these patients
6 Patients for adrenalectomy
7 Patients who have received cortisone at any time previously Such patients are likely to exhibit adrenal cortical insufficiency during or after operation because of suppression of the activity of the adrenal cortex by the cortisone and they should receive the same pre operative treatment as patients awaiting adrenalectomy

PRE OPERATIVE PREPARATION OF THE PATIENT FOR ANÆSTHESIA

Empty Stomach Among the most important aspects of pre operative care from the point of view of the anæsthetist are the measures which must be taken to ensure that the stomach is empty A recent study of the causes of deaths under anæsthesia has shown that the inhalation of stomach contents into the trachea and lungs of the unconscious patient still holds first place

The last meal before operation and it should be a light one must be given at least four hours before the time set for the operation After that nothing should be allowed by mouth and all measures necessary to implement this order must be taken The patient and those on either side of him in the ward are instructed that he is to have

CHAPTER 13

PREPARATION OF THE PATIENT FOR ANÆSTHESIA AND THE DUTIES REQUIRED OF THE NURSE BY THE ANÆSTHETIST IN THE OPERATING THEATRE BLOCK

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THE PRE OPERATIVE PERIOD

The pre operative period is usually considered to commence officially on the patient s admission to hospital but it should be remembered that in reality it commenced when the doctor and patient together agreed upon operation Thus the outpatient nurse or the nurse in the doctor s office, has a very early opportunity to inspire confidence in a patient who has received what must be un pleasant news

Such routine inquiries as the question of smoking of opening of the bowels before admission and even of suitable apparel for the theatre should be answered carefully and kindly though in a matter of fact manner Each operation is to every patient the operation of the year and during the whole of the pre operative period the nurse must try to avoid suggesting either that it is an insignificant item in a busy daily round or that every operation means drama and that few are routine

SMOKING Patients should discontinue smoking or if they are unwilling to do that they should be strongly advised to limit it a great deal during the two weeks before operation or from the time operation is arranged if that is less than two weeks At the very least no smoking should be the rule after admission for operation for smoking not only gives rise to increased irritability of the pharynx larynx trachea and lungs thus increasing the anæsthetic difficulties but in the case of the heavy smoker it is also responsible for the early morning sputum which post operatively causes pain and is difficult to expel This latter difficulty may lead to retention of plugs of mucus in the lungs and as a consequence to the development of small areas of atelectasis which act as a basis for post operative chest complications of an infective nature

ADMISSION On admission the nurse again plays an important role

Diabetes Mellitus Glucose given by mouth greatly prolongs the emptying time of the stomach and it is very irritant to the respiratory passages If glucose is inhaled and the patient survives the immediate danger of drowning death may occur later due to a prolonged bronchospasm or a chemically produced pneumonia Thus, in the present day treatment of the diabetic, glucose is not given orally in the immediate pre operative period instead, the plan of treatment adopted is —

1 If the diabetic is controlled by diet 50 grammes of glucose and 10 units of soluble insulin are given in addition to the diet on the day before and on the day after operation The urine is tested on return to the ward and in some cases an intravenous glucose infusion or insulin will then be necessary (500 ml of a 5 per cent glucose solution contains 25 g of glucose)

2 If the diabetic is on insulin the appropriate caloric equivalent of glucose with the necessary insulin is substituted for the last meal before operation In such a case the glucose is given as one intra venous injection if possible or if it is not an intravenous infusion is set up and continued for twenty four hours after operation or until such time as the patient can resume his normal caloric intake by mouth If the patient is on one of the long acting insulins this is replaced by soluble insulin in the twenty four hours before operation and also in the early post operative period The urine should be tested on return to the ward and fourth hourly thereafter If the patient cannot pass urine every four hours an indwelling catheter should be inserted and *regular* fourth hourly urinalysis performed Insulin is given in divided doses fourth to sixth hourly as required

The Immediate Pre-operative Preparation of the Patient

This should be carried out before giving the premedication as much of the effect of the latter is lost if the patient is subsequently disturbed for other preparations

Skin Preparations and other Relevant Matters These are dealt with in Chapter 8

Labelling of the Patient This should be compulsory and the label should exhibit —

1 The patient s name and age
2 The surgeon s name
3 The proposed operation and if the operation could be performed on either side particularly and accurately the side affected
4 The ward from which the patient has been sent

Patient s Chart This should contain accurate reports on —

1 Temperature
2 Pulse rate

neither food nor drink before operation no matter how thirsty he feels after the premedication The bedside locker should be examined and any drinks fruit, sweets or other food should be removed from it Once the premedication has had effect the patient is not in full command of his actions and senses and then in the absence of suitable precautions, he may inadvertently take something

It should be remembered that in accident cases, in highly nervous patients, and in women in labour emptying of the stomach is much delayed and food may remain in the stomach for many hours If operation cannot be delayed a wide bore stomach tube (Fig 159) should be passed and the stomach emptied in all accident victims who have had any food or drink after the accident or even in the two hours before it Apart from this delay in emptying of the stomach, large quantities of fluid are sometimes given by the ignorant as a restorative measure following an accident Such a misguided act could be the cause of death

It should be remembered that some people may interpret nothing by mouth as meaning no prepared food and it is not always realized that the ban includes fruit and drinks Many a child has been brought to operation by a fond mother who felt her child was being starved, and so has given a lethal glass of milk or piece of fruit in the belief that this will build up his strength for the operation

Apart from these routine measures certain patients require special care in the matter of stomach contents

The patient having laparotomy for a so-called Acute Abdomen should always have a tube such as a Levin s or a Wangensteen's tube (Fig 160) passed and this should be aspirated immediately and at regular intervals the tube remaining in position during operation A Ryle s tube is sometimes used for this purpose but it has the disadvantage of having only very small holes

All cases of gastrectomy should be similarly treated since the pathological condition requiring operation may well have led to delayed emptying of the stomach

Particularly important in this regard of course are cases of intestinal obstruction in which there often are literally pints of fluid in the stomach and bowel above the obstruction Because of this such cases constitute one of the greatest hazards in anæsthesia Many patients have been drowned when the fluid was regurgitated and inhaled, and cases of intestinal obstruction should never be anæsthetised until a Wangensteen s or similar tube has been successfully passed and successfully aspirated The tube is repeatedly aspirated in the ward until no further fluid is obtainable It is left in place when the patient is taken to the operating theatre and there it will be aspirated again before the anæsthetic is started The technique for passing these tubes is discussed in Chapter 7

Movements of the head and neck in the intubated patient (*i e* one with an intratracheal tube *in situ*) may cause unnecessary trauma to the larynx or trachea, or it may initiate a cough reflex which could be troublesome

PREMEDICATION

Premedication is almost universally administered nowadays to the patient before operation, and the two groups of drugs commonly used are —

A The sedative group and

B The atropine scopolamine group

The objects of premedication with Group A drugs are four —

1 In the pre operative stage it should abolish apprehension
2 At operation it should again abolish apprehension and it should dull any perception of pain
3 In the post operative stage it should obliterate or confuse the memory of operation
4 It should lower the metabolism and so allow a smoother induction

In other than emergency cases sedation is usually commenced the night before operation

The objects of premedication with Group B drugs are three in number —

1 To decrease secretions from mouth salivary glands pharynx, trachea bronchi and lungs
2 To decrease the likelihood of laryngeal or bronchial spasm
3 To exert some control over the slowing effect of the vagus nerves on the heart The atropine scopolamine group of drugs inhibits the action of vagus nerves to some extent, and thus it causes an increase in pulse rate

Many drugs have been used in various combinations for premedication, but the general pattern which has emerged over the years is that of firstly, a drug of the hypnotic type administered by mouth and secondly an injection one hour before operation of a drug of the analgesic type together with, at the same time one of the atropine scopolamine drugs

The hypnotic drugs most commonly used are the barbiturates but paraldehyde the bromides chloral hydrate or combinations of these are all used occasionally for this purpose

The barbiturates usually ordered are of the shorter acting types such as Seconal and Nembutal (pentobarbital)

The analgesic drugs commonly used are morphine sulphate omnopon and pethidine hydrochloride

The dosage of any drug ordered must always take into consideration many factors of which the weight age and general condition of the patient are most important

3 Respiratory rate
4 Blood pressure
5 Urine tests
6 Premedication ordered, and the route and time of administration

In addition a special note should be attached to the front of the chart mentioning any —

1 Loose teeth false dentures, or crowned teeth
2 Allergy to specific drugs or dressings
3 Cortisone administration at any time previously
4 Cough, productive or continuously irritative
5 Change in colour or untoward reaction after the premedication
6 Absence of a signature to the form giving permission for anæsthesia

CLOTHING OF THE PATIENT The site of the operation and the type of anæsthetic to be given must both be considered

A suitable garment is a loose fitting gown knee length with short or loose fitting long sleeves and with the neck cut loose and low The short sleeves or the loose fitting long sleeves of the gown should permit access by the anæsthetist to the veins of the forearm and should avoid any constriction of the arm above the elbow which would interfere with its venous return The loose low neck avoids constriction of the airway if the gown tightens with changes in posture during the operation

The gown is made so that it may be put on either way round Thus as required it may be done up in the front or at the back several buttons or tapes being provided for this purpose For example patients for operations on the neck breast shoulders arms, hands, spine chest wall kidneys and the adrenal glands should have the gown tied or buttoned at the back Any binders or dressing towels should be fastened so that they may be easily undone whether the patient is conscious or not

A singlet should not be worn under the gown

Cotton stockings are worn and a cap covers all the hair This cap should be a fashioned one and not a triangle of cotton material The latter has the disadvantage that it must be knotted either at the back, where it is uncomfortable to lie upon, or on the front of the head where it interferes with the application of the anæsthetic head harness

As far as possible any movement of the anaesthetised patient should be avoided as disturbances of blood pressure are very easily induced and this especially applies in the early stages of anæsthesia Rolling or lifting movements such as may be required to get the clothing away from the operation area if it has not been thoughtfully arranged beforehand will certainly disturb the blood pressure

Movements of the head and neck in the intubated patient (*i e* one with an intratracheal tube *in situ*) may cause unnecessary trauma to the larynx or trachea, or it may initiate a cough reflex which could be troublesome

PREMEDICATION

Premedication is almost universally administered nowadays to the patient before operation and the two groups of drugs commonly used are —

A The sedative group, and
B The atropine scopolamine group

The objects of premedication with Group A drugs are four —

1 In the pre operative stage it should abolish apprehension
2 At operation it should again abolish apprehension and it should dull any perception of pain
3 In the post operative stage it should obliterate or confuse the memory of operation
4 It should lower the metabolism and so allow a smoother induction

In other than emergency cases sedation is usually commenced the night before operation

The objects of premedication with Group B drugs are three in number —

1 To decrease secretions from mouth salivary glands pharynx, trachea bronchi and lungs
2 To decrease the likelihood of laryngeal or bronchial spasm
3 To exert some control over the slowing effect of the vagus nerves on the heart The atropine scopolamine group of drugs inhibits the action of vagus nerves to some extent and thus it causes an increase in pulse rate

Many drugs have been used in various combinations for premedication but the general pattern which has emerged over the years is that of firstly, a drug of the hypnotic type administered by mouth, and secondly an injection one hour before operation of a drug of the analgesic type together with at the same time one of the atropine scopolamine drugs

The hypnotic drugs most commonly used are the barbiturates, but paraldehyde, the bromides chloral hydrate or combinations of these are all used occasionally for this purpose

The barbiturates usually ordered are of the shorter acting types such as Seconal and Nembutal (pentobarbital)

The analgesic drugs commonly used are morphine sulphate omnopon and pethidine hydrochloride

The dosage of any drug ordered must always take into consideration many factors of which the weight age and general condition of the patient are most important

3 Respiratory rate
4 Blood pressure
5 Urine tests
6 Premedication ordered, and the route and time of administration

In addition, a special note should be attached to the front of the chart mentioning any —

1 Loose teeth, false dentures, or crowned teeth
2 Allergy to specific drugs or dressings
3 Cortisone administration at any time previously
4 Cough, productive or continuously irritative
5 Change in colour or untoward reaction after the premedication
6 Absence of a signature to the form giving permission for anæsthesia

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If the atropine group of drugs do not have time to exert their drying effect on secretions, such secretions will then be produced in copious quantities once the anaesthetic is started. Later, when the full effect is produced the drying causes the secretions to form into inspissated mucous plugs, which may block bronchi and bronchioles and quickly lead to post operative respiratory complications.

4 The premedication injection is ordered as a rule to be given by hypodermic injection, and the hypodermic route (i e under the skin) is just what is meant. The injection must not be given intra dermally, i e into the skin since that is painful for the patient and absorption of drugs following such an injection is delayed thus upsetting the carefully arranged timing for the effect of the injection.

As already mentioned, due consideration must be always given to the weight and condition of the patient, but in general, the safe dosages of drugs commonly used for premedication are —

HYPNOTIC DRUGS

Seconal	0 75 grains per stone of body weight with an upper limit of 3½ grains
Nembutal (pentobarbital)	0 6 grains per stone of body weight with an upper limit of 3 grains
Paraldehyde	1 drachm per stone of body weight with an upper limit of 7 drachms
Potassium bromide	3 grains per stone with an upper limit *of 30 grains*
Chloral hydrate	2 grains per stone with an upper limit *of 20 grains*

ANALGESIC DRUGS

Morphine sulphate

Age	Dose
4 to 8 years	gr 1/20 or 3 2 mg
8 to 12 years	gr 1/16 or 4 0 mg
12 to 16 years	gr 1/12 or 5 4 mg
Over 16 years	gr 1/12 to 1/4 or 5 4 to 16 2 mg

Omnopon

gr 1/3 of Omnopon is equivalent to gr 1/6 of morphia and the dosage should be calculated accordingly e g at the age of 4 to 8 years morphia gr 1/20 or Omnopon gr 1/10 will be ordered

Pethedine hydrochloride

Age	*Dose*
4 to 8 years	12 to 20 mg
8 to 12 years	20 to 30 mg
12 to 16 years	30 to 50 mg
Over 16 years	50 to 100 mg

The child requires correspondingly less premedication than the adult in proportion to its size whereas the elderly patient requires less premedication because of a slower metabolism

A shocked or anæmic patient also requires much less premedication than expected for size and age

On the contrary, the thyreotoxic patient the hyperexcitable patient or the patient accustomed to large quantities of alcohol or drugs requires in general a larger dose of premedication than is usual for age and size

Inquiry should always be made as to any previous premedication or use of drugs, as it may be discovered that the particular patient is allergic, or unduly sensitive to certain drugs

The time at which the premedication is given is also of great importance Each drug has its optimum time of effect and should be ordered accordingly In general the barbiturates and other drugs of the hypnotic group require a greater length of time (about 90 minutes) to exert their effect than do the drugs of the analgesic group

Certain RULES should be observed in the administration of premedication

1 Never give unquestioningly the dose ordered on the treatment sheet or elsewhere if it does not appear to conform with the known safe dosage of that drug considering the patient s age and weight In such circumstances the dose *must* always be checked with a medical officer Accidents such as the administration of morphine sulphate gr 1/6 to a child aged 8 years instead of morphine sulphate gr 1/16 can happen as a result of a hasty indecipherable scribble by the doctor

It must be noted too that paraldehyde is always ordered in drachms (maximum dose 7 drachms) and *never in ounces* The word drachm should be written in full Symbols should not be employed when ordering this drug

2 The dose should always be checked with a senior nurse or sister and in addition the ampoule or tablet should always be checked before administration

3 The times at which the drugs are to be given is of great importance It is not only useless but quite dangerous to give premedication as or just before the patient leaves the ward for the theatre If the operation time is advanced or if the premedication has been inadvertently overlooked in a busy ward it must never be hastily given close to operation The anæsthetist must be informed and it can then be given by intravenous injection in the theatre

When given hypodermically within 15 minutes of operation these drugs have insufficient time to sedate the patient Maximum sedation with the associated respiratory depression then occurs either during deep anæsthesia in the middle of a long operation or at the end of a short one, in either case with dire results

and there should be no rattling of instruments or trundling of trolleys through this room

A nurse must stay by the patient all the time since this gives him a feeling of confidence Also, as has been already mentioned, a pre medicated patient is not in full command of his actions and may roll and fall off the trolley

Any marked coughing difficulty in breathing, or change in colour observed by the nurse should be reported to the anæsthetist before anæsthesia commences but not in the hearing of the patient Any complaint of sudden pain should be taken seriously and reported, as the emotional stress of an operation can even precipitate a coronary occlusion

ASSISTANCE REQUIRED BY THE ANÆSTHETIST DURING THE INDUCTION AND MAINTENANCE OF ANÆSTHESIA

The various types of anæsthetic require varying types and degrees of assistance from the nurse, once the initial setting up has been carried out

INHALATION ANÆSTHESIA Ether, ethyl chloride, chloroform Trilene Fluothane, nitrous oxide and cyclopropane require little assistance beyond restraint of the patient during the excitement stage of the anæsthetic provision of more anæsthetic material as soon as it is re quested and the handing of the sucker, mouth gag, airways laryngo scope, Magill tubes and intubating forceps when required The nurse must familiarise herself with all these articles, so that if asked for any one of them by an anæsthetist preoccupied with his patient, she will be able to put the correct one into his outstretched hand It is just as important that the anæsthetist does not turn from his patient at a critical time as that the surgeon does not The nurse must also familiarise herself with the way in which the particular operating table is tilted as she may be the only one available to do this in an emergency

INTRAVENOUS ANÆSTHESIA requires more assistance It must always be remembered that until anæsthesia is induced and has reached the level of maintenance operation cannot commence Thus it is useless to have the surgeon and assistant gloved and gowned and ready whilst the anæsthetist is struggling single handed to anæsthetise the patient

Much time can be saved in the induction of the intravenous anæsthesia if the nurse carries out the fixing of the patient s clothing the position ing of the area to be used for venepuncture, the application of the tourniquet and the cutting of any strapping which may be required This can all be done whilst the anæsthetist prepares his solution charges his syringes and checks the gas machine or oxygen supply A steadying hand on the patient s arm during venepuncture especially in children will often save movements which would dislodge the needle The tourniquet should be loosened by the nurse when the

Atropine sulphate

Age	Dose
Under 1 year	gr 1/200 or 0 33 mg
1 to 4 years	gr 1/150 or 0 43 mg
4 to 16 years	gr 1/100 or 0 65 mg
16 to 60 years	gr 1/100 to 1/75 or 0 65 to 0 86 mg
Over 60 years	gr 1/100 or 0 65 mg

Scopolamine

Age	Dose
Under 1 year	gr 1/900 or 0 07 mg
1 to 4 years	gr 1/600 or 0 11 mg
4 to 16 years	gr 1/450 or 0 15 mg
16 to 60 years	gr 1/300 to 1/150 or 0 22 to 0 43 mg
Over 60 years	gr 1/300 or 0 22 mg

Preparation for Spinal Anæsthesia In this method analgesia is produced by the injection of chemical agents into the spinal canal

The skin in the lumbar region at the site of the puncture must receive the same careful preparation as that of the operation site

Relaxation of the anal sphincters is characteristic of spinal anæsthesia Thorough emptying of the rectum prior to the operation and possibly, the provision of a pad of cotton wool on the perineum are therefore required

Preparation for Avertin (Bromethol) Anæsthesia The patient is weighed and the rectum is emptied by an enema earlier that day or the previous evening

DUTIES REQUIRED OF THE NURSE BY THE ANAESTHETIST IN THE OPERATING THEATRE BLOCK

These duties comprise —

1 Setting out the equipment required for ALL anæsthetics (see Chapter 12)
2 Setting out the equipment required for the particular anæs thetic to be given (see Chapter 12)
3 Careful checking of the emergency sets (see Chapter 12)
4 Care of the patient in the anæsthetic room
5 Assistance to the anæsthetist during induction and main tenance of anæsthesia
6 Assistance during emergencies in the operating theatre
7 Care of the patient at the close of anæsthesia and assistance to the anæsthetist at this time

CARE OF THE PATIENT IN THE ANÆSTHETIC ROOM

The first need of the premedicated patient in the anæsthetic room is quiet and the nurse should take all measures necessary to produce silence Doors should be closed no conversation should be held

and there should be no rattling of instruments or trundling of trolleys through this room

A nurse must stay by the patient all the time since this gives him a feeling of confidence Also, as has been already mentioned, a pre medicated patient is not in full command of his actions and may roll and fall off the trolley

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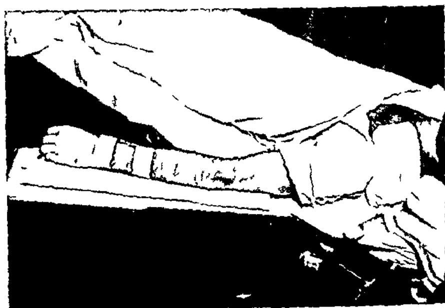


Fig 195 One of the correct positions for the arm during intravenous anæsthesia



Fig 196 INCORRECT position for an arm

The arm is too abducted the board on which the arm is resting is *inserted* too far *down the* body it is being pushed against by the surgeon and the hand is lying *on* the tubing of the intravenous infusion set and on the Mitchell needle It will also be seen that this needle is lying on the unsterile board

anæsthetist gives the word, and she should then stand by and hold the patient s jaw, provide any strapping required, and check any movement of the arm or the patient until such time as the anæsthetist has performed other necessary manœuvres and has his hands free

Requests for (a) further supplies of the drugs which are being used (b) for other drugs or (c) for full oxygen cylinders should be met immediately, the level of anæsthesia varies much more quickly with intravenous anæsthesia than when ether is the anæsthetic agent

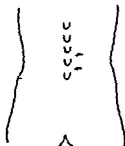


Fig 197 The sites for lumbar puncture are between the third and fourth lumbar vertebræ or between the fourth and fifth lumbar vertebræ

Spinal Anæsthesia The assistance of the nurse is particularly required during the induction of spinal anæsthesia for this must be carried out with strictest aseptic precautions and the anæsthetist is, of necessity, gowned and gloved for the greater part of the procedure

Assistance is mainly required for the posturing of the patient, and commences with the fixing and checking of the shoulder rests of the table If the table is to be tilted after the injections have been made, this must be done rapidly There should be no delay in posturing the patient since the heavy solutions commence to fix in the spinal canal in a matter of seconds and the spinal levels to which the anæsthetic rises depend on the degree of tilt Thus, all *must* be in readiness for the movement of the table

The position of the patient during spinal puncture is of great importance The spaces between the spinous processes should be separated as far as possible and the dura mater will then be as taut as possible Full flexion of the patient is necessary to produce these results

If the puncture is to be made with the patient in the lateral position he lies with his knees drawn up against his chin and arms folded across his chest The nurse stands facing him with one arm under the knees and the other round the back of his head and thus, the pressure of her arms steadies the patient during injection and increases the flexion (Fig 198) As soon as the injection is finished he is turned on to his back and the table tilted as required The nurse should note the time of the injection

If the puncture is to be made with the patient sitting up he should sit with elbows on knees the head on the hands and the spine fully flexed (Fig 199) The nurse once again stands facing him with one arm across the back of his neck and shoulders to keep him fully flexed and to prevent his swaying to either side or moving during the injection When the injection is made, he either remains sitting until the fixing time of the anæsthetic elapses or is immediately laid on his back and

the table tilted Once again the nurse should note the time of injection

Nowadays for spinal anæsthesia the anæsthetic solution is usually a heavy' or hyperbaric one that is its specific gravity is heavier than that of the cerebrospinal fluid and it therefore sinks in the cerebrospinal fluid It is because of this difference in weight of the fluids that at the conclusion of the injection the patient is gently rolled over on to

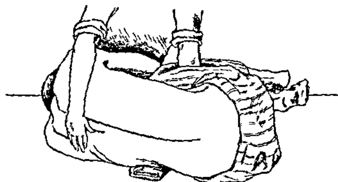


FIG 198 The patient is being held with the spine fully flexed so that a spinal anæsthetic may be given

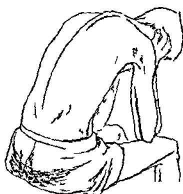


FIG 199 The patient is sitting up and the spine is fully flexed by dropping the shoulders downwards and by pushing the lumbar portion of the spine backwards

his back and the buttocks are raised if it is desired to increase the level to which analgesia rises up the abdomen and trunk At the same time the head is kept slightly raised on a pillow for at least 10 minutes During these 10 minutes all the anæsthetic agent will be fixed to the nerve structures and after that it will not gravitate up to the head even if the Trendelenburg position is used

The duration of the analgesia varies somewhat the average time being about one hour with procaine and about two and a half hours with Nupercaine whilst the time from injection to complete analgesia is from two to ten minutes

Thirst is frequently complained of, and occasionally there is pallor and sweating The patient should be reassured and the head should be lowered If the pallor or sweating persists or if nausea or vomiting occurs an injection of a vasopressor drug will be required

In order to counteract the fall in blood pressure which occurs during spinal anæsthesia an injection of Neo Synephrine (5 mg in ½ ml) or ephedrine hydrochloride gr ½ to ¾ (32 to 48 mg) is given just prior to the injection of the spinal anæsthetic agent Subsequently if the blood pressure does fall as indicated by nausea vomiting or giddiness and by the blood pressure reading an injection of Neo Synephrine (7 5 mg in ¾ ml) or Methedrine (20 mg in 1 ml) may be given The spinal anæsthetic agent paralyses the nerves to many of the blood vessels of the body, thus allowing them to dilate and thereby causing a fall in the blood pressure This dilatation of the blood vessels is overcome by the ephedrine Neo Synephrine or Methedrine

EPIDURAL AND CAUDAL ANÆSTHESIA require the same assistance with posturing and turning as for spinal anæsthesia save that with epidural anæsthesia the puncture is made in the lateral position with the knees drawn up, but the back straight and with caudal analgesia the puncture is actually made with the patient in the prone position with a pillow under the pelvis making the sacral area prominent

LOCAL ANÆSTHESIA Here the nurse may be required to prevent movement of the patient but great assistance can also be rendered by a nurse being gowned and gloved in order to prepare and drape the patient and to re charge syringes with solutions

When the patient is transferred to the operating table from the trolley after a spinal epidural caudal or local anæsthetic soft gauze rolls or padded straps should be used to fasten the limbs a strap should be placed round the thighs and an eye piece should be placed over the eyes and fastened with strapping

These patients are usually heavily premedicated and involuntary movements not necessarily induced by pain may occur

The practice of giving sips of water to these patients should be abandoned as if any supplementary general anæsthetic is required all the complications of inhaled stomach contents become likely

A nurse should remain at the patient s side throughout the operation and she will then be at hand should restraint be required

TOPICAL ANÆSTHESIA For this type of anæsthetic the best assistance the nurse can give is to hold the head of the patient perfectly steady whilst the nose is packed or the throat sprayed She should have ready to hand a kidney dish for the patient will probably need to spit out saliva and excess solution For the same purpose a small towel for wiping the lips and nose is useful These patients should be supervised by the nurse in both the anæsthetic room and the operating theatre until operation commences as fainting or the occasional toxic reaction

may occur and need immediate treatment Faintness, giddiness, sudden pallor or twitching should be reported to the anæsthetist at once

INTRATRACHEAL ANÆSTHESIA The passage of an intratracheal tube, its fixing, and the attachment of the patient to the source of an anæsthetic agent or oxygen can be greatly facilitated by the intelligent nurse It is during these procedures that the anæsthetist most often wishes he had at least three hands

Firstly anæsthesia is induced by one method or another, and relaxation of the jaw muscles and larynx is achieved Then, the laryngoscope is passed, the vocal cords exposed and the Magill tube passed through them either nasally or orally The laryngoscope must be held in one hand whilst the tube is passed with the other, and during this the nurse may be asked for the Magill intubating forceps or a larger or smaller tube Steadying of the head may also be necessary With the tube in position through the cords, it must be held in position until fixed with strapping or some other aid, and these the nurse must also have ready If the metal connection for the Magill tube is not already *in situ* it must now be inserted and the patient connected to the anæsthetic source Some form of fixing agent for this tube or tubes leading to the anæsthetic machine is then required, a head harness or bandage etc otherwise the weight of the tubes may drag the carefully placed intratracheal tube back through the larynx not only causing inconvenience and waste of time but actual damage to the vocal cords

AVERTIN (BROMETHOL) ANÆSTHESIA Whenever possible the patient is taken to a quiet darkened room Failing that the bed is screened off from the rest of the ward The patient lies in the left lateral position of Sims with the foot of the bed raised, and a catheter is inserted four inches into the rectum The anæsthetic solution, having been prepared by the anæsthetist is poured slowly into a funnel on the end of the catheter and two or three minutes are taken to run it into the rectum The patient is usually asleep in three minutes and should not be disturbed in any way for twenty or thirty minutes

ASSISTANCE TO THE ANÆSTHETIST DURING EMERGENCIES IN THE OPERATING THEATRE

If possible assistance to the anæsthetist during anæsthesia should be the duty of one particular nurse This makes for time saving and increased efficiency at all times but during emergencies the time saved may be of vital importance to the patient

The emergencies of the operating theatre are —

(A) Vomiting under anæsthesia
(B) Respiratory arrest
(C) Sudden massive hæmorrhage

(D) Cardiac arrest
(E) Fire or explosion, and
(F) Intra arterial injection of sodium thiopentone (Pentothal)

With the exception of sudden massive hæmorrhage which no one but the surgeon can stop the anæsthetist must, of necessity, deal with the remaining emergencies, and to do that it is essential for him to have intelligent planned assistance by the nurse

(A) Vomiting Vomiting and the inhalation of the vomited matter into the larynx and lungs is one of the commonest causes of death under anæsthesia, and all efforts must be directed to prevent such an occurrence The head of the table must be lowered, so that the fluid will collect in the pharynx and nasopharynx and suction must be carried out promptly If the vomiting occurs early in anæsthesia the jaws may be tightly clenched making suction extremely difficult and a mouth gag will often be necessary to prise the jaws open After suction has been undertaken it may be necessary to intubate the trachea This necessitates a laryngoscope intratracheal tubes and connexions intubating forceps and a suction catheter which will pass through the lumen of the Magill tube If the vomited matter has been aspirated and the patient s colour is not satisfactory bronchoscopy will be carried out and so the emergency bronchoscope with bronchoscopic suction tube will be needed

The sucker (with a catheter for use as a sucker and an ordinary sucker head) will be required at the close of operation, as will the laryngoscope to ensure that no particles of vomited or regurgitated matter remain in the pharynx

It will be evident from the above that the duties of the nurse in this emergency are —

(a) To understand the mechanism of the operating table so that the head may be lowered at once
(b) To hand to the anæsthetist a mouth gag and the sucker switched on and sucking
(c) To recognize and have ready to hand to the anæsthetist when pharyngeal suction is complete a laryngoscope Magill tube with connexions Magill forceps and suction catheter
(d) To ask if bronchoscopy is required and prepare the emergency bronchoscope and sucker

(B) Respiratory Arrest As a rule the only nursing assistance required during this emergency is that of standing beside the anæsthetist ready to produce articles which he may require until respiratory movements return Inadvertent respiratory arrest constitutes an emergency because a few minutes complete anoxia of the patient will produce cardiac arrest with all its attendant dangers

(C) Sudden Massive Hæmorrhage The surgeon will of course stop this hæmorrhage at once by pressure either with fingers or pack

but upon the anæsthetist devolves the task of rapidly replacing the blood volume so that the venous return to the heart is impeded only for as short a time as possible, and so that operation may continue with safety

If a transfusion is already in progress and running well only extra supplies of volume expanders, blood, serum, or serum albumin and some artificial means of increasing the speed of the transfusion such as a Julian Smith pump are necessary

If there is no transfusion already set up it must be started at once, and this is often a difficult procedure The blood pressure will have fallen sharply and the veins of the extremity will be collapsed, the tourniquet making little or no difference to them In this case a cut down set will be required so that venesection may be performed and a cannula inserted into the vein Strapping will be required to fix this in position The nurse must familiarize herself with the procedure for opening the various types of infusion bottles and connecting them to the intravenous set so that, when the cannula is in position, the set may be immediately fixed to it and as little time lost as possible

Since so much blood with its oxygen carrying capacity, has been lost, oxygenation of the patient at this time is extremely important The anæsthetist has his hands fully occupied and so if other medical aid is not present the nurse must be prepared to set up and administer oxygen This may be given with a nasal catheter with a bag and mask or better still if the patient is attached to the gas machine by rhythmically and gently squeezing the rubber bag of the machine under the anæsthetist s verbal guidance

To summarize these duties When sudden massive hæmorrhage occurs the nurse should —

(i) Get extra supplies of blood if it is available or of intravenous fluids (serum albumin serum, dextran or at least dextrose saline) if there is no blood

(ii) Open the bottle and attach the giving set ready for the anæsthetist to connect it to needle or cannula

(iii) Have strapping ready for fixing the tubing and needle or cannula in position

(iv) Be prepared to administer oxygen to the patient

(D) CARDIAC ARREST Cardiac arrest is fortunately not a common disaster but when it does occur its treatment must be immediate and efficient for permanent damage to the brain occurs after three minutes complete cerebral anoxia

The complete plan for the treatment of cardiac arrest is included here as it is felt that all should have clearly in mind the necessary steps and thus the points at which assistance will be required Such a plan should be permanently placed in a conspicuous place in each operating theatre

The first necessity is, of course, knowledge of the position of the emergency sets and of the emergency drug drawer amongst the anæsthetic equipment There is no time for anyone to describe where they are

Secondly, a working knowledge of the mechanism of the operating table is again essential so that it may be tilted

Thirdly, the nurse should be familiar with the equipment needed for lung inflation so that it may be handed in the right order to the anæsthetist

Once again if other medical aid is not available, the nurse must be prepared to inflate the lungs under instructions whilst the anæsthetist prepares the various drugs and equipment necessary or she must be ready to prepare the drugs checking them with the anæsthetist whilst he inflates the lungs

Plan for the Treatment of Cardiac Arrest

(To be displayed in the operating theatre)

DIAGNOSIS This must be early Irreparable cerebral damage occurs with 3 minutes complete cerebral anoxia

Signs —

1 Apnœa
2 Colour waxy pale or cyanosed
3 Absence of peripheral pulse,
4 Absence of bleeding in wound and
5 Fully dilated pupils

Request that the surgeon palpate a major vessel, if available Do not waste time trying to record a blood pressure

TREATMENT Remember that you are providing an artificial circulation and respiration until the normal cardiac action returns

1 Tilt the table with the patient s head down

2 Inflate the lungs with 100 per cent oxygen by gas machine or by bag and mask If necessary, inflate by mouth to mouth insufflation Do not waste time at this stage trying to intubate the larynx Intubate later

3 Attempt to restart the heart by a quick right auricular puncture with a fine 3 inch needle through the 2nd right intercostal space

4 Open the chest in the left 4th or 5th interspace from the border of the sternum to the anterior axillary line avoiding the internal mammary artery

Note whether the heart is at standstill or is fibrillating

Commence to squeeze the heart 50 to 60 times a minute

Do not squeeze with the finger tips a flabby heart may perforate

The heart should be lifted in the whole hand and compressed against the sternum Massage to be adequate *must* produce a carotid pulse at once

Continue massage until a blood pressure of 40 to 60 mms systolic can be recorded Then

1 Incise the costal cartilages above and below the incised interspace
2 Insert a rib spreader
3 Open the pericardium longitudinally
4 Intubate the larynx
5 Relieve the surgeon doing the massage (Two surgeons relieving each other at intervals of five minutes should be the rule) MASSAGE MUST CONTINUE BETWEEN THESE PROCEDURES

Then check to see whether asystole or fibrillation is present

ASYSTOLE or cardiac standstill The heart is flabby dark and motionless

Continue pumping until normal contractions are resumed If these are weak and inadequate —

1 Stimulate the myocardium by injection into the left auricle of 3 to 10 ml of adrenalin 1/10 000 or 0 3 to 1 ml of adrenalin 1/1 000 in 3 ml of saline

2 Compress the aorta distal to the origin of the left subclavian artery to increase the pressure of the blood to the coronary arteries and brain

If there is no normal heart beat after several minutes of artificial circulation —

1 Inject into the left auricle 3 to 10 ml of adrenalin 1/10 000, or 0 3 to 1 ml of adrenalin 1/1 000 in 3 ml of saline

2 Inject into the left auricle 3 to 4 ml of 10 per cent calcium chloride

This restores tone to the heart muscle and may initiate contraction

Continue Pumping between Injections These injections may have to be repeated but hope must not be lost until pumping has continued for a long period and whilst the pupils remain contracted

FIBRILLATION The heart appears as if a series of shimmering small waves are passing over its surface or the movement may be coarse

The most effective way to abolish ventricular fibrillation is by electric defibrillation

This will cause asystole and regular manual compression of the heart is then undertaken

If the heart is fibrillating —

1 Establish artificial circulation and respiration

2 Apply the two electrodes firmly to the heart one posteriorly to the apex the other to the anterior aspect of the base of the heart

The electrodes must be well covered with saline pads to prevent burning the heart

3 Give 1 shock for 0 25 seconds at 180 volts

If arrest occurs treat as above

4 If still fibrillating massage and give a second similar shock

5 If still fibrillating, massage, and give 5 to 7 shocks at intervals of 0 5 to 1 second

More than one series of shocks may be necessary and compression of the heart should be carried out between each set of shocks

If electrical methods fail —

1 Inject procaine hydrochloride, 10 ml of a 1 per cent solution or procaine amide hydrochloride 10 ml of a 10 per cent solution into the heart, or

2 Inject 5 ml of a 4 per cent solution of potassium chloride into the heart

Both these drugs will cause asystole *Continue pumping* If this asystole persists —

1 Inject 0 3 ml of 1 in 1,000 adrenalin in 3 ml saline or

2 Inject 3 ml of 1 in 10 000 noradrenaline *plus* 3 to 4 ml of a 10 per cent calcium chloride solution

Once the natural circulation is restored —

1 Augment and support it with transfusions and noradrenaline if necessary (in some cases there is considerable depletion of the circulating blood volume and this must be corrected as soon as possible)

2 Secure the bleeding points especially the internal mammary artery near the sternal border

3 Suture the pericardium loosely with interrupted sutures

4 Suture the costal cartilages

5 If the normal heart beat has now continued uninterruptedly for some minutes close the chest, using an underwater seal

If artificial circulation was not restored in 3 to 4 minutes cerebral œdema from anoxia will almost certainly occur and measures must now be taken to prevent this These include —

1 The intravenous injection of 100 ml of 50 per cent sucrose solution and repeat this injection 4th hourly

2 The intravenous injection of 100 ml of 0 1 per cent procaine hydrochloride (without adrenalin) twice daily about 20 minutes being taken for each injection

The most important points in this plan should also be printed and prominently displayed These are —

CARDIAC ARREST
You have 3 minutes
1 Lower the Head of the Table
2 Inflate the Lungs with 100 per cent Oxygen
3 Open the Chest (4th or 5th left space) and Compress the Heart 50 to 60 times a minute

(E) Fire and Explosion Nursing assistance in this instance falls mainly into the category of prevention Two elements are present in the production of a fire or explosion —

(i) An explosive or inflammable agent or mixture
(ii) A source of ignition

It is the task of the anæsthetist to see that as far as possible the two elements do not come together

The explosive or inflammable anæsthetic agents in common use are ether, ethyl chloride and cyclopropane

An explosive or inflammable mixture may be a combination of any of these agents with nitrous oxide or oxygen

It may also be an inflammable gas generated within the body such as flatus in the lower bowel or stomach gases, particularly in pyloric obstruction

It is the nurse's task to eliminate as many of the sources of ignition as are within her power

It should be remembered that the use of the diathermy after cleansing the skin with ether or spirit can cause a fire

The sources of ignition in the operating theatre are —

(a) Non static electricity
(b) Static electricity
(c) Other sources of heat
(d) Spontaneous ignition

(a) The commonest sources of Non static Electricity are the diathermy endoscopes electrical apparatus such as sucker motors X ray machines and the electrical switches themselves

It is most necessary to see that diathermy is properly earthed by sufficient wetting of the plate or pad or the current may travel by an alternate route such as through the metal of the face piece or through the anæsthetic apparatus

Endoscopes may cause trouble if indiscreet increase of the light strength causes the bulb to burst and the filaments are then exposed in an area where explosive mixtures are present A filament or diathermy loop not even at red heat may cause an explosion

Even though most modern electrical equipment for use in operating theatres is made spark proof all such equipment should be raised as far as possible Ether vapour is heavier than air and this falls in a stream to the floor Electrical switches should be at least three feet from the floor and they should be arranged so that any electrical appliance cannot be plugged or unplugged unless the switch is off If this arrangement is not present care must be taken that no switch is ever left on when not in use

(b) Static Electricity Static sparks are more likely in a dry atmosphere They are generated by many things such as the drawing of blankets over rubber topped trolleys the rubbing of silk or nylon

underwear, the movement of rebreathing bags and the passage of gases through rubber hoses on gas machines etc Prevention is directed first of all to the elimination of the above sources An attempt is made to keep the theatre air slightly moist (fortunately ancient electrical equipment goes hand in hand with ancient sterilizers) Blankets are covered with cotton sheeting and in some theatres the wearing of silk or nylon is forbidden Rebreathing bags and rubber hoses may be dampened with soapy water before use

Prevention is then directed to dispersal and earthing of the charges

Floors are often specially constructed of conducting substances, such as Terrazzo interspersed with metal strips If they are not washing with soapy water or polishing with anti static wax is of assistance

Anti static rubber, that is conducting rubber has been developed for dispersal of these charges It is now used for all the rubber components of the gas machine for trolley wheels and for rubber mattresses, pillows pads etc and it has replaced the small chains on gas machines trolleys etc which were formerly used for earthing the pieces of apparatus Unless shoes with soles made of anti static rubber are available, it should be remembered that leather soles are safer than ordinary rubber for theatre staff

(c) OTHER SOURCES OF HEAT It should scarcely be necessary to mention electric radiators, fans and sterilizers with open flames as sources of ignition which must be eliminated from any contact with the explosive agents But the nurse must be ever on the watch, in the ward as well as the theatre for the presence of the two elements together The preparation of the skin of one patient with ether whilst the one in the next bed smokes a cigarette must be ever in mind as must ether skin preparation by the light of an old fashioned flame light At least one death has been caused by the conflagration resulting when such a lamp was overturned

(d) SPONTANEOUS IGNITION This may occur when oil or grease comes in contact with highly compressed oxygen All oxygen cylinders carry a warning of this danger

(F) INTRA ARTERIAL INJECTION OF SODIUM THIOPENTONE (PENTOTHAL) This is usually a relatively minor emergency but nursing assistance is required

Such an injection causes intense spasm of the artery and great irritation to its lining leading to thrombosis and occlusion of the vessel and in some instances this has caused gangrene and loss of the limb

The objects of treatment are therefore to relieve spasm and prevent thrombosis

For relief of spasm vasodilators such as Priscol and papaverine hydrochloride will be used and these should be prepared for the anæsthetist

Brachial plexus block will also be carried out so the autoclaved pack and solutions used for local anæsthesia will be needed

For prevention of thrombosis intravenous heparin will be required therefore the autoclaved pack for intravenous injection must be provided

Finally the limb must be swathed in thick cotton wool

ASSISTANCE TO THE ANÆSTHETIST AT THE CLOSE OF ANÆSTHESIA AND CARE OF THE PATIENT AT THIS TIME

The close of the operation and anæsthetic is frequently a time of great importance for the well being of the patient

It has been mentioned before that movement of the patient can cause marked changes in blood pressure and this must be particularly stressed at this juncture The patient who has been just maintained at normal levels during a long operation may be precipitated into shock by injudicious handling at the end of operation All movement should be gentle and gradual If the patient has been head downwards in the Trendelenburg position, the table must be gradually restored to the horizontal position over a period of ten minutes or more whereas if the lithotomy position has been used the legs should be slowly lowered one at a time and gently placed on the table If the patient has been in the lateral position gentle lifting to the supine position should be carried out by a number of persons adequate to support the patient s weight Much rolling from side to side and tugging to get a binder in position must be avoided This should either be laid on the trolley and fastened after the patient has been moved on to it or it should be applied later on

Dressings to lateral and posterior wounds should be prepared and applied expeditiously so that the intratracheal tube may be removed from the intubated patient who will be rapidly coming out of his anæsthetic and perhaps gagging on this tube and biting it

Before removing any intratracheal tube the anæsthetist will suck out the pharynx and post nasal space and will pass a catheter sucker through the intratracheal tube thus removing any mucus in the trachea The laryngoscope suction catheter and ordinary sucker head should therefore be provided by the nurse

A vomit bowl mouth gag and towel should also be close to hand

If a transfusion or an intravenous infusion is being administered a padded splint and bandage should be provided for fixing the area before the patient is moved Care should be taken during movement that the bottle of fluid is kept raised well above the level of the patient

If an intrathoracic drainage tube is present a check should be made to ensure that the tube is either clipped off (which is preferable) or attached to an underwater seal which must be kept below the level of table or trolley top If the water bottle is raised above the level of

the patient's chest the water will be sucked back along an unclipped tube into the chest cavity, with time consuming and dangerous results

After the patient has been given into the care of the nurse by the anæsthetist she should remain with the patient until he or she is transferred to the ward staff

A report should be made at once to the anæsthetist if any of the following are observed —

(i) Noisy respiration This usually indicates obstruction to the airway
(ii) Very rapid or very slow respiration
(iii) Poor colour either cyanosis or pallor whenever there is any doubt about it the colour is not right
(iv) Change in the pulse rate either increase or decrease
(v) Change in the pulse volume
(vi) Sweating
(vii) Slowing or cessation of the intravenous drip

REFERENCE

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CHAPTER 14

DUTIES REQUIRED OF THE NURSE IN THE POST OPERATIVE PERIOD INCLUDING THE CARE OF UNCONSCIOUS PATIENTS

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Transport of the Patient from the Operating Theatre to the Ward

The nurse supervising transport of the patient should —

1 Be fully conversant with the methods of care of the airway in the unconscious patient as described on page 249 During transport back to the ward it is her chief duty to maintain an unobstructed airway

The occurrence of obstruction to the airway by blood, mucus or vomitus requires that the patient is immediately returned to the theatre for suction or taken to a recovery ward provided with a sucker, whichever is the quicker

2 Receive from the anæsthetist any special instructions for the care of the particular patient during transport

3 Ensure that the case notes of the patient are complete with post operative instructions and are returned with the patient to the ward

4 Check that on the trolley there are near the head of the patient an artificial airway of appropriate size a mouth gag and a kidney dish or bowl

5 Keep the patient warm

6 Keep a careful watch over the position of the limbs especially making sure that the arms do not hang over the side of the trolley If this is allowed to happen pressure on the radial and other nerves may occur which will cause muscular paralysis especially of those muscles which dorsiflex the wrist and which extend the fingers The elbows and other parts of the body should not project beyond the trolley for they may be injured in doorways lifts etc

7 Prevent damage to the eyes which may occur if towels or bed clothes are carelessly placed or if movements of the head cause the open eye to come in contact with the mattress or bedclothes



FIG 200 After the completion of an anæsthetic the patient is placed in almost the prone position the head is turned to the side over a pillow and the jaw is held forwards Note the strap around the buttocks the label on the wrist the Guedel airway in place and the arm by the side

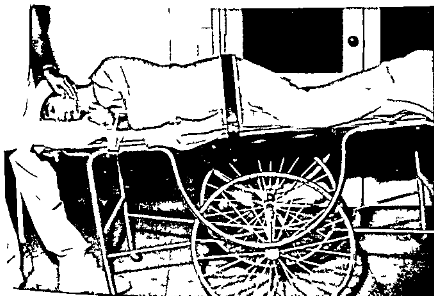


FIG 201 On the trolley for transport back to the ward the jaw is held forward the patient is lying on the side and is fixed in position with a strap around the buttocks No portion of the body is projecting beyond the trolley

8 Care for any intravenous infusion or transfusion which the patient is receiving If the blood or other fluid is being given intra venously the reservoir of fluid should be supported well above the patient and care is essential to ensure that at no time is the tubing kinked the needle or cannula dislodged air allowed to enter the tubing of the giving set or the reservoir of fluid allowed to become com pletely empty

9 Care for drainage tubes attached to bottles

Care of the Patient after Spinal Anæsthesia

On return to bed the patient will be conscious nevertheless a nurse should be in constant attendance until recovery from the analgesia is complete

POSITION Unless it is contraindicated because of the possible development of a chest infection or of a general peritonitis the patient is usually kept flat for the first twenty four hours During this time a small pillow may be allowed but sudden changes in posture should be avoided

INCONTINENCE OF URINE AND FÆCES Analgesia of the bladder and rectum resolves late Urine and fæces may be passed without the patient s knowledge whilst in other cases retention of urine develops

WARMTH Until analgesia passes off the legs will be quite insensitive to heat Hence because of the possibility of the patient being burnt no matter how much care is taken a hot water-bottle should not be used

HEADACHE Freedom from shaking and steadiness whilst moving the patient on to his back are distinct factors in preventing the occur rence of subsequent headaches This symptom is usually relieved by lying down and by the administration of a preparation containing aspirin gr xv

Care of the Patient after Avertin Anæsthesia

On being returned from the operating theatre the patient is placed in the lateral position Restlessness excitement and vomiting are rare and the patient usually wakes as from sleep in three to five hours During that time however constant supervision is necessary

If restlessness occurs it may be readily controlled by a small dose of morphia (gr 1/8 to 1/6) given hypodermically but morphia tends to intensify the action of Avertin and hence the administration of larger doses is prone to introduce the real danger of respiratory depression

Respiratory depression following upon Avertin anæsthesia and endangering the life of a patient may be controlled by the intravenous or intramuscular injection of 1 5 to 3 mls of a solution of nikethamide (Coramine) Ephedrine hydrochloride also has the power of interrupt- ing or shortening the narcotic effect of Avertin

CARE OF THE UNCONSCIOUS PATIENT IN THE WARD

Unconscious patients may be divided into two groups depending on the length of the period of unconsciousness

Group I

These patients are expected to recover consciousness in a short time They include patients who have received a general anæsthetic and are ready for return to the ward and patients suffering from a mild overdose of sedative drugs

In this group the cough reflexes of the larynx and pharynx are present, and, consequently, blood, stomach contents and mucus are prevented from entering the trachea and lungs Provided a clear airway is maintained and respirations are adequate recovery will be uneventful

The Duties of the Nurse in the Care of this Group of Unconscious Patients

These are to —

1 Constantly watch over the airway The word airway is used here to denote the passageway for the transference of oxygen, carbon dioxide and anæsthetic gases between the mouth and nose and the lungs, *i e* it is the nose, mouth, naso pharynx, pharynx, larynx, trachea and bronchi,

2 Observe the respirations,

3 Observe the patient s colour

4 Observe the pulse,

5 Observe the skin

6 Observe the pupils

7 Observe the blood pressure

8 Check any intravenous therapy which is in progress

9 Observe any drainage tubes which are present and the drainage from them

1 THE AIRWAY

With ALL unconscious patients even if the period of unconsciousness is only one of seconds a constant watch over the airway is always the prime consideration Cyanosis is a LATE sign of obstructed or depressed respiration and it should always be so regarded

Other signs of respiratory obstruction are snoring crowing and depressed or absent respirations and of these the most frequently observed is snoring respiration This is due to relaxed tongue muscles which allow the tongue to fall against the posterior pharyngeal wall (Fig 202) and the following measures should be employed until the breathing is quiet and regular —

Hold the jaw forward (Fig 203) by pushing the forefinger behind the angle of the mandible (Fig 204) taking care not to hold the

mouth tightly closed This is especially important in a patient who has had a nasal operation and whose nose may have been packed with gauze

If holding the jaw forward does not serve introduce an artificial airway This is constructed of firm rubber or metal, and is curved to

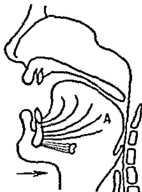


FIG 202 Diagram to show the tongue (*A*) falling backwards and blocking the airway



FIG 203 Diagram showing how the airway is cleared when the jaw and tongue are held forwards

fit over the back of the tongue When in place the lax tongue is separated from the posterior wall of the pharynx and a free airway established (Fig 205) Artificial airways are of several sizes and the appropriate size for the patient adult or child should be selected



FIG 204 The patient is lying on the back and the jaw is being held upwards and forwards



FIG 205 Diagram showing a Guedel airway in position

Such an airway is introduced in the following manner —

(a) Stand behind the patient s head

(b) Open the mouth with the left hand by pulling the lower jaw downwards

(c) Gently place the non flanged end of the airway between the tongue and the hard palate, and slide it backwards following

the curve of the tongue with the curve of the airway until the flange just rests outside the teeth

(d) Push the jaw forward and check that the breathing is now quiet and regular

(e) Check that the tongue or lower lip is not caught between the airway and the teeth If the artificial airway causes coughing or crowing respiration, it may be too long and should be removed a shorter one then being tried

When the obstruction is due to blood mucus or vomitus in the pharynx introduction of the artificial airway may cause an explosive cough which will get rid of this matter, but, should this not occur the foreign material must be sucked out until the pharynx is empty

It is of scant use to administer oxygen until the manœuvres to clear the airway have been carried out No oxygen will enter the trachea and lungs through an obstructed pharynx or larynx

Crowing respiration is indicative of obstructed respiration, and should be dealt with as above unless cyanosis supervenes In that case passage of an intratracheal catheter and suction by a medical officer may be necessary

Depressed respiration may also be due to obstruction of the airway, as may absent respiration, and the above measures must be carried out as the first step to assure a clear airway Administration of oxygen analeptic drugs and artificial respiration should then be undertaken as required

2 OBSERVATION OF THE RESPIRATION

Mention has already been made of some of the changes in respiration which must be watched for changes which denote obstruction in the airway Other abnormalities are those of rate and rhythm

INCREASE IN RATE

Marked increase in respiratory rate and consequent decrease in depth that is rapid shallow breathing will very quickly lead to cyanosis and anoxia with carbon dioxide (CO_2) retention if it is not reported and corrected The shallow respirations do not allow sufficient time for the exchange of carbon dioxide in the lungs In such cases oxygen should always be given until inflation of the lungs can be undertaken

Rapid shallow respirations may denote hæmorrhage since a falling blood pressure with a rising pulse rate stimulates the respiratory centres Thus the operation site and drainage tubes should be inspected

DECREASE IN RATE

Marked lessening in the number of respirations per minute should always be reported at once A respiratory rate of 6 per minute or

less without the administration of 100 per cent oxygen may very quickly lead to cyanosis

Variation in Rhythm and Depth

This is most often a sign of returning consciousness, but, if the variation regularly recurs, that is if there is a regular change from quiet shallow respirations to deep respirations and then a gradual falling off once more oxygen should be administered and a report made This type of breathing is known as Cheyne Stokes respiration and indicates some gross interference with the mechanisms of the respiratory centre

Regular jerky respirations accompanied by chin tugging (the chin is jerked downward with each respiration) also indicate grave dysfunction of the respiratory centre, oxygen should be administered and medical aid summoned forthwith This sign may be seen if the patient has had a relaxant drug (and long inflation) and has been sent from the theatre before the effects have been sufficiently reversed It is usually accompanied by rapidly developing cyanosis

3 Observation of the Patient s Colour

The fundamental rule in the observation of the colour of the patient is the appreciation of the fact that if any doubt about the colour exists in the observer s mind the colour is not normal

The colour changes may be slight, but there is never any doubt when the colour returns to normal Pink lips pink earlobes pink finger nails and the faint pink glow of the normal skin of face and hands are quite unmistakable

The colour changes which must be watched for in this group of unconscious patients are —

A Cyanosis in varying degrees
B Pallor

A Fully developed CYANOSIS is a sign of severe oxygen lack, and it is characterized by the colour of the patient which may be anything from an unmistakable amethyst to a navy blue It is of the gravest import in the unconscious patient for if the cause is not sought and treated vigorously and successfully cardiac arrest will inevitably occur

The lesser degrees of cyanosis are much harder to recognize The colour may appear just not quite right but it must be understood that this appearance goes hand in hand if untreated with a slowly developing vicious circle of oxygen lack to the tissues which causes cardiac and respiratory depression and this in turn leads to further oxygen lack Thus inevitably but perhaps too late for treatment in the case of the patient with damaged cardiac musculature the cyanosis becomes fully developed

It requires 5 g per 100 ml of hæmoglobin in the blood to produce enough reduced hæmoblobin to give the cyanotic colour Thus, in

shocked or anæmic patients with the hæmoglobin reduced below this level a grave degree of obstruction and oxygen lack may be present without cyanosis occurring Whenever these conditions exist, extra vigilance is therefore essential

The Treatment of Suspected Anoxia

Whenever anoxia is suspected, as judged by the patient s colour, treatment is as follows —

- (i) Extend the patient s head slightly and push the angle of the jaw forward as described above
- (ii) If this does not improve the colour at once insert an artificial airway if one is not already in place
- (iii) Listen carefully, with an ear near the airway and observe the type of respiration and the presence of any bubbling noise, which indicates obstruction by fluid in the airway If this is present insert a sucker through the mouth and carefully suck out the nasopharynx and pharynx
- (iv) If there is no improvement at once give oxygen at the rate of 4 litres per minute with a catheter inserted into the nose or artificial airway
- (v) If no improvement occurs send for medical aid Whilst this is coming prepare the sucker and suction catheter laryngoscope Magill tubes and connections and attach the rebreathing bag to the oxygen cylinder
- (vi) If the colour is deteriorating apply the mask of the inflation set firmly to the patient s face and hold it there Turn up the oxygen flow to 6 litres per minute and fill the bag with oxygen Then gently inflate the patient s lungs about 12 to 14 times a minute Successful lung inflation is indicated by the rise and fall of the chest with each pressure on the bag and by a general improvement in the colour

If the bag empties completely on pressure and no movement of the chest occurs make sure that the mask is being applied firmly over the nose and mouth with no leakage and that the expiratory valve on the mask mount is screwed down Then inflate again

If inflation is difficult and the feeling is one of resistance some obstruction is present in the airway Again check the airway as far as possible and inflate once more If obstruction is still present it must be at the laryngeal level or below Do not use extra force with inflation at this point as the oxygen will only be forced down the œsophagus and will inflate the stomach instead Continue with the gentle inflation using only one hand until help arrives

B Change of the unconscious patient s colour from normal to one of PALLOR should always call for increased vigilance

Pallor may be due either to vaso constriction from some cause the commonest being shock, or to lack of hæmoglobin in the circulating blood The course of action to be taken is as follows —

(i) Check the operation site and the drainage tubes if any Hæmorrhage may then be quite obvious

(ii) Check the pulse chart Increase in pulse rate with a decrease in pulse volume indicates hæmorrhage or shock

(iii) Take the blood pressure If this is low (normal is 120 mms systolic and 80 mms diastolic) or if repeated readings show a progressive fall, it is further evidence that shock or hæmorrhage is present

(iv) Check the rate of the intravenous drip if one is running

(v) Report to the anæsthetist

(vi) Give oxygen Pallor always indicates decreased peripheral oxygen supply, and this rapidly affects the brain A flow of 4 litres per minute through an unobstructed airway is the minimal requirement

4 OBSERVATION OF THE PULSE

Any change of the rate or volume of the pulse is particularly important in the unconscious patient

Progressive slowing of the pulse rate may be just as indicative of serious trouble as a rising pulse rate and should be reported at once A fall in pulse rate to 65 per minute or less may be the prodromal sign of cardiac arrest

If the patient has received a relaxant drug during operation and Prostigmin for its reversal, a watch must be particularly kept for this sign The Prostigmin requires at least 10 minutes for its full effect to become evident and if given late in the operation or immediately before the patient leaves the theatre for the ward marked slowing of the pulse may occur in the ward and will require the immediate injection of more atropine to counteract the Prostigmin

A rising pulse rate often indicates shock or hæmorrhage and this is particularly likely when it is accompanied by a lowered blood pressure and a poor pulse volume The same steps should then be taken as with patients exhibiting sudden pallor

If the rising pulse rate is associated with

(a) a slight rise in blood pressure and an increased volume of the pulse

(b) flushing

(c) sweating of the skin the airway should again be carefully checked as there may be some obstruction to elimination of carbon dioxide (CO_2)

If an excess of carbon dioxide in the blood is not soon reduced it will have a direct toxic effect on the heart and respiratory centre

5 OBSERVATION OF THE SKIN

In addition to observing changes in the colour of the skin, a note should also be made as to whether the skin is moist or dry

The following changes should be remembered —

A *Shock and hæmorrhage* may be accompanied by a pale cold, moist skin

B If there is *carbon dioxide accumulation* the skin will be moist but warm and flushed

C *Overdosage with Prostigmin* may be associated with a warm moist skin but in these cases there will also be

(a) much secretion of saliva in the mouth,
(b) slow pulse rate,
(c) a falling blood pressure

6 OBSERVATION OF THE PUPILS

Unless some grave emergency occurs, the pupils of this group of unconscious patients should be medium to small in size and they should react to light

7 OBSERVATION OF THE BLOOD PRESSURE

Ideally all patients who have been anæsthetised or unconscious for more than one hour should have a quarter hourly blood pressure chart but this is not always practicable In certain cases, however this chart *must* be kept These are —

(i) Patients who have had operations on the adrenal glands or who have had operation following cortisone therapy at any time in the past
(ii) Patients whose blood pressure is low on return to the ward
(iii) Patients who have had operations on the heart the great vessels, or the lungs
(iv) Patients who have had hypotensive techniques used with their anæsthetics *i e* those patients in whom the blood pressure has been deliberately lowered during the anæsthetic
(v) Patients who have had operations on the brain
(vi) Hypertensive patients who have had operations lasting an hour or more

A progressive *fall* in blood pressure should always be regarded as an emergency If untreated an irreversible state may be reached with the blood pressure remaining low for so long that heart failure occurs Also the longer the fall of blood pressure is unrelieved, the more involved are the measures required to raise it

Accordingly whenever a fall in blood pressure is recorded, it should be reported at once Pending more active treatment the head of the patient should be lowered and the feet raised

For the treatment of this emergency the following should be immediately available —

(a) Oxygen,

(b) Ampoules of ephedrine hydrochloride (gr $\frac{1}{2}$ to $\frac{3}{4}$ in 1 ml) Methedrine (30 mg in 1 5 ml), Neo Synephrine (10 mg in 1 ml) or perhaps noradrenaline (4 mg in 4 ml, 1 ml of which is added to 250 or 500 ml of glucose or saline before use It is given by a slow intravenous infusion The recently introduced Levophed Special Solution, which is given intravenously as a single dose of 0 2 mg and without dilution, shows promise of being of more value than noradrenaline in these patients)

(c) Cortisone (100 mg for intramuscular injection), or Solu Cortef (100 mg in 2 ml for intravenous injection)

(d) Intravenous infusion set with blood albumin, serum or, perhaps, dextran supply

Patients who are hypertensive that is, those whose resting blood pressure is above normal are particularly sensitive to any sudden change in blood pressure, and must be handled with increased care A sudden fall may precipitate a cerebral thrombosis, whilst a sudden rise following a prolonged and marked fall may well be the cause of a cerebral hæmorrhage

8 CHECKING OF INTRAVENOUS THERAPY

A successful intravenous drip has the following features —

(a) It will run at the rate required for as many hours as required

(b) Increase in rate from drip to a steady stream will be possible if necessary

(c) The intravenous needle or cannula will be so placed that there is minimal interference with it on movement of the patient

Factors affecting these features are —

(i) The blood pressure of the patient

An intravenous infusion will not run successfully when the blood pressure is very low *i e* when it is 60 mms systolic or less Raising the height of the bottle above the patient or a blood accelerating mechanism attached to the set will then be necessary

(ii) The size and patency of the needle or cannula in the vein

At least a 19 gauge needle is required and this should always be tested for patency before puncture of the vein and again if the drip is not running

(iii) The situation of the needle or cannula

The needle or cannula must remain within the lumen of the vein and the point should not lie against the wall of the vein for this may block it Careful fixing of the needle or cannula by strapping or tape should avoid this trouble If the needle is outside the vein the fluid will drip causing a swelling in the tissue round the needle but the rate

cannot be increased to a steady stream Under these circumstances, that is, swelling of the tissues plus a slow rate of drip the set should be clipped off but it should not be removed from the patient until medical aid has arrived Often the same vein will be found to be still useful

(iv) The giving set comprising puncture needle for the bottle, filter and dripper and rubber or plastic tubing See Chapter 7

Occlusion of the rubber tubing by pressure between stand and bed or by one of the patient s limbs should be looked for and corrected

The drip regulator may be inadvertently left tightly on when the infusion bottles are changed This should be checked

The drip chamber may be full of blood or other fluid so that the drops cannot be seen It is then necessary to lower the level of the fluid in the drip chamber

The filter is frequently a cause of lack of success, and when all other causes are eliminated the filter should be replaced

The puncture needle *i e* the needle through which the blood or fluid runs out of the bottle, may be blocked or it may be of too small a gauge and under such circumstances it should be replaced Once again at least 19 gauge needles should be used for this purpose If blood is being given slowly, the bottle should be shaken occasionally

(v) The bottle and air vent needle

One of the common causes of failure of an intravenous drip to run is the height of the bottle This is always best raised as high as the stand will permit

The air vent needle must be patent, and kept so If air does not enter the bottle freely through this needle, the reduction in pressure in the bottle will prevent the fluid s running out the other needle It is better if the air vent needle projects above the fluid level in the bottle, but it should not lie against the top of the bottle If occluded by blood clot it must be replaced

If the drip becomes progressively slower and cannot be increased to the desired rate on releasing the clamp and raising the bottle the procedure to be followed by the nurse or medical officer watching the intravenous therapy is —

(a) Check the pulse and blood pressure

(b) Check that there is no pressure on the tubing

(c) Check that the tissue round the needle is not swelling as this suggests that the needle is out of the vein

(d) If possible detach the infusion set from the intravenous needle or cannula and make sure that the blood or other fluid will run freely through the set If not check the set from the bottle down

(e) If the blood or fluid is running freely through the set check the patency of the intravenous needle or cannula Attach a 2 ml syringe containing sterile saline or dilute citrate solution and attempt injection

For the treatment of this emergency the following should be immediately available —

(a) Oxygen,

(b) Ampoules of ephedrine hydrochloride (gr $\frac{1}{2}$ to $\frac{3}{4}$ in 1 ml) Methedrine (30 mg in 1 5 ml) Neo Synephrine (10 mg in 1 ml) or perhaps noradrenaline (4 mg in 4 ml, 1 ml of which is added to 250 or 500 ml of glucose or saline before use It is given by a slow intravenous infusion The recently introduced Levophed Special Solution, which is given intravenously as a single dose of 0 2 mg and without dilution, shows promise of being of more value than noradrenaline in these patients)

(c) Cortisone (100 mg for intramuscular injection), or Solu Cortef (100 mg in 2 ml for intravenous injection)

(d) Intravenous infusion set with blood albumin serum or, perhaps, dextran supply

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The Duties of the Nurse in the Care of this Group of Patients Suffering from Prolonged Unconsciousness

These are —

1 Care of the airway and prevention of pulmonary complications
2 The provision of adequate respiration
3 The observation and charting of pulse and temperature
4 The care of the skin and genitalia
5 Observation and care of the eyes
6 Recording of the blood pressure
7 Care of the intravenous infusion and keeping of the fluid balance chart
8 Care of the nose mouth and ears
9 Care of the limbs

1 CARE OF THE AIRWAY AND THE PREVENTION OF PULMONARY COMPLICATIONS

Once again the airway is of first importance Here the protective laryngeal and pharyngeal reflexes are lost and unless many precautions are taken stomach contents fluid and mucus will enter the trachea and lungs without hindrance

Cuffed intratracheal tubes will of course prevent aspiration of fluids into the lungs but, after a matter of hours they cause damage to the vocal cords and to the tracheal mucous membrane and thus for these patients a tracheostomy is often performed This will require constant nursing care

Mucus is constantly being formed in trachea and bronchi and must be frequently sucked out in order to avoid pulmonary complications The suction is performed with a suction catheter passed through the tracheostomy This manœuvre must be performed extremely gently with due regard to the delicate nature of the tracheal and bronchial mucous membrane and this is particularly important when the suction has to be repeated

To prevent crusting and drying of these secretions a detergent solution such as Alevaire (Bayer) is used in the form of a fine spray through the tracheostomy during part of every hour If a cuffed tube is in use in the tracheostomy it should be changed every twelve hours

2 RESPIRATION

The respiration is almost always depressed or impaired in these patients and in many of them continuous artificial respiration will be necessary This will be provided by a machine such as the Beaver or the modified Bennett respirator There is also a Bennett model for augmenting respiration in a patient who is breathing but in whom oxygenation and carbon dioxide exchange is inadequate

(f) If the intravenous needle is patent, re attach the infusion set and report the failure Do not remove the needle or the giving set, miracles do happen and it may start again

It is essential to safeguard and preserve every possible vein of the patient against a future emergency and the greatest care should be exercised when handling a patient having an intravenous infusion so that even one extra venepuncture will be avoided

It must also be remembered that the giving of a blood transfusion or an intravenous infusion is a sterile operation Accordingly, the air vent needle should only be held by that portion which will remain outside the bottle The remaining length of the needle which passes into the blood or fluid should not be touched

When changing the reservoir of fluid its label must be very carefully checked, and this applies especially whenever a bottle of blood is being set up The patient s name should be on the bottle of blood supplied and, in addition, the number of the bottle should correspond with the number on the pathologist s report of the compatibility of the blood The expiry date of the bottle will also be noted The blood group of the bottle of blood will be the same as that of the patient with the exception that occasionally Group O 4 blood will be used for the transfusion *No other difference in the grouping is ever permissible*

GROUP 2

This group comprises patients in whom the period of unconsciousness lasts many hours days or even weeks The principles of care are much the same whatever the cause

Long periods of unconsciousness may occur —

(a) Following a head injury or a cerebral vascular lesion,
(b) Following a massive overdose of sedative drugs
(c) Following a long period of anoxia during anæsthesia,
(d) Following surgery on the brain
(e) Due to cerebral tumours
(f) Associated with metabolic disturbances such as uræmia or diabetes
(g) Associated with infections such as meningitis and cerebral abscess
(h) In cases of tetanus when it is deliberately induced with sedative drugs and anæsthetics and
(i) In bulbar poliomyelitis and combined bulbar and spinal poliomyelitis

In general these patients exhibit loss of all protective reflexes and for survival require unremitting nursing and medical care

The care of these cases follows along the general lines of the care of the first group of unconscious patients but with many important additions

4 THE SKIN AND GENITALIA

Care of the skin is of great importance In all cases remaining in one position for any great length of time pressure sores are very prone to develop and this is especially so in these cases, as there is loss of skin sensation

Frequent changes of posture must be employed and the skin must be kept dry and massaged over the pressure points Loss of bladder and bowel sensation causing incontinence may add to the difficulty here consequently catheterization and a daily enema to avoid soiling of the bed may be necessary

Care of the genitalia must not be omitted These patients have lowered resistance to infection and are prone to develop vulvitis or balanitis if care is not exercised A thorough daily toilet with an antiseptic irrigation should be performed if there is even the slightest indication of infection

5 THE EYES

The pupils must be carefully observed in these patients as variations in size and equality and the presence or absence of a light reflex may give the clue to a change in the depth of unconsciousness either a lightening or a deepening

In the deeply unconscious patient the lids may retract drying of the eyes will occur and, subsequently conjunctivitis and corneal ulceration will develop The frequent changes of posture which are essential may also lead to injury to the eyes, and this possibility must be remembered The eyes should be irrigated twice daily with Normal saline and the lids kept gently closed with a two inch square of tulle gras

6 BLOOD PRESSURE

A blood pressure chart is essential in patients in a state of prolonged unconsciousness, and unless the condition is one where variations are of great importance in diagnosis or treatment this should be an hourly chart

It has been noted in tetanus cases that a fresh spasm requiring more anæsthetic or sedative is always preceded by a rise in blood pressure

7 INTRAVENOUS THERAPY

It will be obvious that patients who are unconscious for long periods must receive nutrition either by tube feeding or by intravenous infusion Disturbances of the electrolyte balance dehydration and vitamin deficiencies must occur if adequate replacement is not made

A fluid balance chart is absolute essential and must be constantly checked for accuracy

Over hydration is just as important as fluid deficiency In these patients the incidence of pulmonary complications is high but it will be much higher if too much fluid is given

3 PULSE AND TEMPERATURE

The careful recording on a chart is once again of great importance For instance a progressive slowing of the pulse rate in a case of head injury or cerebral tumour usually indicates an increasing intracranial pressure and such a case may require urgent surgery

The temperature in these cases is usually lowered due to paralysis of the voluntary muscles, and nursing in a warm room with plenty of blankets is required Hot water bottles are absolutely contraindicated because of the complete loss of sensation in the skin Burns which may be fatal can rapidly occur in such patients

High temperature is usually due to infection, but may also be due to a cerebral lesion In either case the nursing measures used for lowering a high temperature may be required

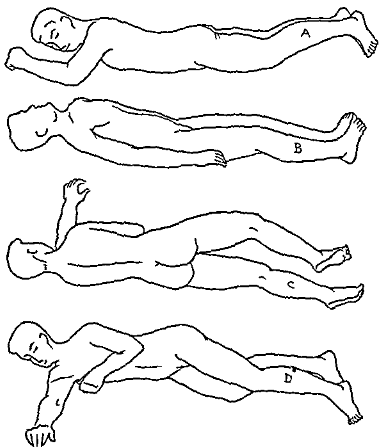


FIG 206 Positions for the unconscious patient

A Prone *B* Supine *C* Left lateral and *D* Right lateral The patient is moved from one of these positions to another at least every two hours The first change in position should be when the patient is moved on to the trolley from the operating table

CHAPTER 15

IMMEDIATE POST-OPERATIVE CARE

ON the patient s return to the ward attention is required to the following points —

THE POSITION OF THE PATIENT The patient is generally placed in the prone position (Fig 206A) with the head low and turned so that the tongue falls to one side

POST ANÆSTHETIC VOMITING During vomiting the head should be left low, and the head or the patient himself turned to one side so that the vomit runs out of the corner of the mouth A vomit bowl is placed under the patient s mouth and the lower jaw is held forwards by pressure behind the angle of the jaw

OBSTRUCTED RESPIRATION This usually results from the falling backwards of the root of the tongue which blocks the entrance of air into the larynx The respirations gradually become more and more stertorous and the patient becomes cyanosed and if the condition is not relieved death will be due to asphyxia The tongue must be drawn forwards and this may be accomplished by the nurse lifting the lower jaw forwards by placing her fingers behind the angle on either side If this fails, the mouth should be forcibly opened by a gag the tongue pulled well forwards and an airway inserted

If an injection of a relaxant has been given during an anæsthetic some weakness of the diaphragm and other muscles of respiration may persist after the patient has left the operating theatre Con sequently, these patients require even more careful watching than usual The airway must be free at all times and, if respiration is very depressed or ceases artificial respiration must be commenced immediately

Obstruction to respiration may arise from the entrance of vomitus into the air passages and in this case the mouth should be forcibly opened by a gag and any *debris* removed

WARMTH If the temperature of the ward is low warmth must be maintained by hot blankets If a hot water bottle is ordered by the surgeon it must be covered by several thicknesses of blankets It must always be remembered that an unconscious patient may not move away from a hot bottle before a burn occurs A hot bottle should never be left in or placed in a bed with any patient unless this has been specifically ordered by the surgeon

The frequent change of posture calls for added care of the intra venous infusion by the nurses

These patients suffer from venous stagnation, and thrombosis in the veins occurs easily Often the infusion must run over a period of days or weeks, and each vein is doubly precious

8 THE NOSE THE MOUTH AND THE EARS

The nose Drying of the skin and mucous membrane may lead to sores and ulceration around the nostrils, and therefore frequent cleansing and applications of an ointment are necessary

The mouth No fluid is being swallowed, the resistance of the patient is lowered and thus drying infection and ulceration are very apt to occur in the mouth Infection may spread into a parotid gland and cause suppurative parotitis *The mouth should therefore be frequently* cleansed and swabbed with glycerine and borax, etc

The ears Cases of fractured skull may have a leakage of blood or cerebrospinal fluid from the ears and occasionally the ears may even contain vomited matter Daily examination and cleansing of the ears (but *not syringing*) should be carried out in order to avoid infection

9 THE LIMBS

The services of the physiotherapist should be employed from the outset in these cases since stiffness contractures thrombosis and embolism readily occur as a result of the muscle weakness and lack of movement

Passive movement of all joints is essential, as is frequent change of posture and a two hourly or more frequent change of posture should be the rule

From the above description of the care of patients suffering from prolonged unconsciouness it should be obvious that if this constant attention is to be given by the staff of a general ward, the treatment of patients who are less acutely ill must suffer Many hospitals therefore *now possess a Recovery Unit or Intensive Therapy Unit In these* units all the necessary emergency equipment is concentrated and many of the nursing personnel are specially trained

As a result of such special and individual treatment the general overall picture is now one of a greatly increased efficiency and accord ingly a greatly improved prognosis has emerged for these patients

The Lateral Position This is the natural sleeping position of most people and owing to its comfort should be permitted whenever possible

As a preventive measure against venous stasis the patient should not be left in the same position for more than an hour or so

To make the patient comfortable in the lateral position pillows are used some supporting the back, one under the forearm and elbow of the elevated side and one between the knees

Early Ambulation As soon as possible (usually about two days after an abdominal operation) the patient should be encouraged to get out of bed into a chair The following day he should be walking around the room

The advantages of early ambulation are —

1 Less stasis occurs in the veins of the legs because of the movements of the muscles and as a result there is less likelihood of venous thrombosis and of pulmonary embolism

2 The tone of the muscles returns to normal more quickly, and there is less loss of strength during convalescence

3 Pressure sores are much less likely

4 Respiration will be deeper and hypostatic pneumonia uncommon

5 The mental outlook will be improved

6 Convalescence will be shortened

2 THIRST This is one of the most distressing symptoms following severe operations and bears a direct relation to the shock the blood lost and the amount of the vomit

Unless there is some definite contra indication such as an operation on the stomach or bowel the patient should be allowed to quench his thirst with suitable fluids *e g* hot weak tea but they must be taken slowly and the quantity given at one time must not exceed four ounces

If it is inadvisable to give fluids by mouth, intravenous injections of glucose and saline should be administered Rectal injections of tap water are occasionally used as a temporary measure but only a very limited amount of fluid is absorbed from the rectum

3 POST ANÆSTHETIC NAUSEA AND VOMITING Post anæsthetic nausea and vomiting are probably due to both a local condition of the stomach and to an effect on the central nervous system

Since the alimentary canal is an important excretory organ the vomiting following an anæsthetic may be regarded as a physiological process due to the excretion into the stomach of anæsthetic drugs present in the blood Bad cases of post anæsthetic vomiting may thus be due to a gastritis set up by the anæsthetic

After inhalational anæsthetics there is often a certain amount of vomiting Usually it consists of only a little mucus but occasionally it may be severe and persist for hours or even days

The prophylaxis with regard to the restrictions of diet catharsis etc has already been discussed in Chapter 8

It is essential that the nurse should be in constant attendance until the patient has completely recovered from the anæsthetic

Further details of the care of unconscious and anæsthetised patients are given in Chapter 14

The Subsequent After-treatment The chief points to pay attention to in the late after treatment of operation cases are —

1 THE POSITION OF THE PATIENT There are three postures that are usually adopted after operations —The dorsal recumbent the semi recumbent and the lateral position

The Dorsal Recumbent From the standpoint of the nurse it is certainly the most convenient position for nursing and feeding the patient, but few people are accustomed to sleeping on their backs



FIG 207 After operations on the testicle the scrotum may be supported on strapping between the legs The top edge of the strapping should not be taut or it will cause pain by pressing on and perhaps cutting into the scrotum

and the skin covering the sacrum and other bony points of the back is badly adapted for bearing continuous pressure Some patients complain more of their backs than of the operation wound

The Semi recumbent Position (Fowler s Position) Here the patient is propped up in bed into a half sitting position with pillows and a bed rest at his back, a pillow at his feet and the foot of the bed raised to prevent his slipping down the bed

This is the posture usually used after operations on the abdomen and chest especially for elderly people who are liable to develop hypostatic pneumonia and cardiac insufficiency On the other hand it has the disadvantage that it is not a perfectly comfortable position and patients are often unable to sleep in it It is quite easy however, to turn the patient carefully to the side usually adopted without causing any harm to the wound, and in many cases the patient then drops off to sleep in a few minutes

To maintain this position the attendant nurses have to lift up the patient several times each day

The High Fowler s Position sometimes used in cases of spreading peritonitis is similar to the above except that the head of the bed is raised on blocks some eighteen inches high

packing the wound firmly with gauze and by not applying strong antiseptics to the wound

Immobilization of the wound usually may be secured by flexing the joints so as to relax the neighbouring muscles (*e g* slight flexion of the trunk after laparotomy) and also by applying splints in such a way as to inhibit movement of the wound

The post operative reparative inflammation does not cause severe pain unless infection supervenes In that case the pain may be very effectively relieved by elevating the part or by the application of heat

The pain after certain operations notably bone and rectal operations, may be very severe In the lesser cases acetyl salicylic acid gr xv (1 Gm) may be given, but in all cases of intense pain morphia or a similar drug should be administered unless specially contra indicated

After some operations a few surgeons will order regular doses of an opiate or similar drug to be given whether the patient is complaining of pain or not For example, after a hæmorrhoidectomy 100 mg of pethidine hydrochloride may be ordered orally every eight hours for the first four days Even with such therapy, injections may also be required An order for such routine administration has much to recommend it Patients vary in their threshold for pain, that is some patients feel pain more than others and it is often difficult for the nurse to estimate the severity of the pain and the need for relief Also some patients complain much more than others and if the administration of drugs depends on the frequency and obtrusiveness of their complaints, then the patient with good self discipline may be deprived of relief There is also the fact that in a busy ward the opiate requirements of one convalescent patient several days after operation may be overlooked because more attention is being given to other seriously ill patients Apart from that, it seems that drugs administered for the relief of pain are more effective if the pain is not allowed to become very severe before they are given

Nurses and students are often taught to fear the induction of drug addiction but this is most unlikely to develop in the few days while a patient is in severe pain and is not a justification for withholding an injection The fact that the patient realizes that the morphia and pethidine will relieve his pain and asks for them should not be taken as proof that he is becoming an addict Furthermore if a patient is in severe pain after an abdominal operation his respiratory movements will be shallow and an atelectasis (collapse) of the lung bases which may even lead to pneumonia is likely Also, if pain is allowed to persist shock may increase Thus apart from humane considerations there are good medical reasons for ensuring that the pain is relieved

5 Post Anæsthetic Conjunctivitis Although it is customary to attribute this to a careless anæsthetist who has allowed the anæsthetic liquid or gas to enter the patient s eye a more likely cause is the

A further point is that the patient should be moved back to bed from the theatre very carefully, as jolting and shaking only increase the vomiting

After the patient has regained consciousness, the giving of warm water say up to ℥viii, dilutes the offensive material in the stomach, and if the patient vomits, no harm is done, for he merely washes out his own stomach While the stomach is in this irritable condition it is incapable of digesting food, and hence it is advisable to avoid feeding for at least twelve hours Food should not be given until the vomiting ceases

Various remedies for the treatment of post operative nausea and vomiting are sometimes worth trying in mild cases These include —

(i) Two ounces of iced black coffee containing fifteen grains (1 Gm) of bromide of potassium

(ii) Two ounces of iced champagne containing ♏ii (0 12 ml) of dilute hydrocyanic acid repeated every two hours

(iii) One minim (0 06 ml) of liq iodi mitis in a teaspoonful of water every hour

(iv) Giving the patient a feeder containing bicarbonate of soda ʒi aromatic spirit of ammonia ʒi, and eight ounces of water

However these methods are not reliable and more active measures may be necessary

For prophylaxis against post operative vomiting Largactil (chlor promazine) may be given in 25 to 50 mg doses by mouth or by intramuscular injection but if nausea and vomiting develop the Largactil may be repeated every four hours (Largactil is one of the newer drugs known as tranquillizers and it is also useful in patients who are suffering from alcohol or drug addiction)

As an alternative Dramamine (dimenhydrinate) tablets (50 to 100 mg) may be given orally every four hours or Andramine tablets (50 mg) may be given every three hours These two preparations are used with much success for the treatment of seasickness and they may be equally successful in the treatment of post operative vomiting

In addition to these drugs a mild sedative such as sodium pheno barbitone gr iii (195 mg) or paraldehyde 5 ml by intramuscular injection may help

In cases of severe post operative vomiting a Wangensteen s (or similar) tube should be passed and the stomach washed out This gastric lavage is repeated till the return is clear Thereafter the stomach is kept empty by aspiration whilst there is any tendency to vomit

4 PAIN Post operative pain is generally due to movement tension or inflammation of the wound but it was formerly also due to stimulation of nerve endings in the wound by antiseptics Post operative pain is lessened by not drawing the sutures tightly by not

mouth for at least twelve hours, and then only light and easily assimilated food

Milk should be the mainstay in post operative cases, but it has the disadvantage that it is liable to cause flatulence and constipation It may, however, be rendered more assimilable by removing the fat (*e g* skimming off all cream) or by boiling or by the addition of lime water, soda water, or potassium citrate to render the clot or curd less dense

Semi solids such as custard, jelly, bread and milk etc, are sometimes more readily retained than fluids and they certainly are more satisfying to the patient

Food which necessitates chewing such as dry toast, broiled steak and chops, may be ordered soon after operations not involving the gastro intestinal tract

Provided no complications have arisen, the diet may be gradually increased after the third day

8 FLUIDS The total exchange of water per day for a healthy adult is approximately as follows —

INTAKE		OUTPUT	
Fluids	1,450 ml	Urine	1 500 ml
Water content of solid foods	800 ml	Skin	600 ml
Water of oxidation	350 ml	Lungs	400 ml
		Fæces	100 ml
Total	2 600 ml	Total	2 600 ml

It therefore follows that administration of fluid becomes essential for the prevention and treatment of dehydration

If owing to nausea or post operative vomiting adequate oral intake is not possible then recourse should be made to the administration of fluids intravenously or subcutaneously After all operations on the intestinal tract, fluids by mouth should be withheld for six to twelve hours or longer

The function of the kidneys is to excrete the waste products of the body amounting to some thirty five grammes (540 grains) daily

With healthy kidneys concentrating urine to a specific gravity of 1 032 the excretion of half a litre of urine may suffice but with damaged organs able to concentrate only to 1 010 at least one and a half litres of water will be required, failing which retention of nitrogenous waste products must occur

It is not always realized that a healthy individual loses about a litre of water daily by insensible perspiration from the skin and by

drying of the conjunctival sac occurring under general anæsthesia due to temporary separation of the lids and diminished secretion of tears It may also be due to a corneal abrasion by the edge of the mask or to the anæsthetist who gauges the depth of anæsthesia by testing the corneal reflex and thereby damages the corneal epithelium

This complication should therefore be preventable but as a prophylactic measure it is wise to instil a few drops of castor oil into each eye on the patient s return from the theatre

6 Sleeplessness The commonest cause of sleeplessness after operations is undoubtedly discomfort, and this should be rectified at once It may be due to various causes, such as an uncomfortable position or uncomfortable bed thirst, tightness of the dressings or a distended bladder

DRUGS | DAY OF ILLNESS | P M 5 6 7 8 9 10 11 12 A M 1 2 3 4 5 6 7 8 9 10 11 NOON 12 1 2 3 4

1 2 3 4 5 6 7 8 9 10 11 12

MORPHI g 1/6 | MEDINAL g 7 /2 | MORPHIA g V

Fig 208 Sleep Chart The periods of sound sleep are indicated by the continuous lines and restless dozing by the interrupted lines

When the insomnia is due to pain morphia pethidine or acetyl *salicylic acid gr xv (1 Gm) with codeine phosphate gr ½ (32 mg)* is *usually necessary to secure a good night s rest*

The too frequent variation of the nurse s report from the patient s own version draws attention to the great difficulty in assessing the actual duration of real sleep

A sleep chart however furnishes a fairly accurate record throughout the twenty four hours and gives an estimate of how the patient is faring

All nurses on night duty in hospital should wear rubber soles and heels on their shoes and those with an unduly heavy tread should take lessons in deportment

7 Diet The diet after operation varies somewhat according to the particular operation undergone but even after operations not involving the gastro intestinal tract no food should be given by the

mouth for at least twelve hours, and then only light and easily assimilated food

Milk should be the mainstay in post operative cases, but it has the disadvantage that it is liable to cause flatulence and constipation It may however be rendered more assimilable by removing the fat (*e g* skimming off all cream) or by boiling, or by the addition of lime water soda water, or potassium citrate to render the clot or curd less dense

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It is not always realized that a healthy individual loses about a litre of water daily by insensible perspiration from the skin and by

water vapour with the expired air This amount will be greatly increased both during and subsequent to any major operation

If the patient is given his correct post operative fluid allowance as Normal saline solution he will receive one ounce of salt in the twenty four hours and may have difficulty in excreting such a large amount

All patients who are vomiting who are drinking poorly who are receiving fluids by intravenous or other injection who are suffering from suppression of urine, or who are suffering from an intestinal or biliary fistula should have their fluid intake and output accurately recorded so that any tendency to retention of fluids or to dehydration may be recognized and corrected

Such a record constitutes a Fluid Chart These charts are usually arranged on a twenty four basis and the intake and output are added up and compared every twelve or twenty four hours

Restriction of fluids is badly borne by patients who have recently undergone a major surgical operation

The keeping of a fluid chart is one of the most important duties of the nurse who has the care of a seriously ill patient

FLUID CHART

TIME	INTAKE					OUTPUT				
	Mouth	Stomach tube	Intra venous	Subcut aneous	TOTAL	Vomitus	Urine	Aspira tion	In visible loss	TOTAL
6 a m										
7 a m										
8 a m										
9 a m										
10 a m										
11 a m										
12 md										
1 p m										
2 p m										
3 p m										
4 p m										
5 p m										
6 p m										
7 p m										
8 p m										
9 p m										
10 p m										
11 p m										
12 m n										
1 a m										
2 a m										
3 a m										
4 a m										
5 a m										
6 a m										
TOTAL										

The amount received by injection down a tube into the stomach duodenum or small bowel

The amount aspirated from the stomach duodenum small bowel or from a fistula *e g* biliary or duodenal

The invisible loss from the skin lungs fæces which amounts to about 1 100 ml or more per day according to the weather and to the condition of the patient

water vapour with the expired air This amount will be greatly increased both during and subsequent to any major operation

If the patient is given his correct post operative fluid allowance as Normal saline solution he will receive one ounce of salt in the twenty four hours and may have difficulty in excreting such a large amount

All patients who are vomiting, who are drinking poorly who are receiving fluids by intravenous or other injection, who are suffering from suppression of urine, or who are suffering from an intestinal or biliary fistula should have their fluid intake and output accurately recorded so that any tendency to retention of fluids or to dehydration may be recognized and corrected

Such a record constitutes a Fluid Chart These charts are usually arranged on a twenty four basis and the intake and output are added up and compared every twelve or twenty four hours

Restriction of fluids is badly borne by patients who have recently undergone a major surgical operation

The keeping of a fluid chart is one of the most important duties of the nurse who has the care of a seriously ill patient

Fluid Chart

Time	Intake					Output				
	Mouth	Stomach tube	Intra venous	Subcut aneous	TOTAL	Vomitus	Urine	Aspira tion	In visible loss	TOTAL
6 a m										
7 a m										
8 a m										
9 a m										
10 a m										
11 a m										
12 md										
1 p m										
2 p m										
3 p m										
4 p m										
5 p m										
6 p m.										
7 p m										
8 p m										
9 p m										
10 p m										
11 p m										
12 m n.										
1 a m										
2 a m										
3 a m										
4 a m										
5 a m										
6 a m										
TOTAL										

The amount received by injection down a tube into the stomach duodenum or small bowel
The amount aspirated from the stomach duodenum small bowel or from a fistula *e g* biliary or duodenal
The invisible loss from the skin lungs fæces which amounts to about 1 100 ml or more per day according to the weather and to the condition of the patient

9 ELECTROLYTES *Sodium Chloride (NaCl)* The basic needs of the body for sodium chloride (salt) are only fifteen to thirty grains (1–2 Gm) a day, and seventy five grains (5 Gm) has been considered an adequate allowance Further, it has been shown that when more than this amount has been administered and the kidneys are not functioning efficiently the excess sodium chloride has the power of retaining water in the tissues (œdema) and there may even be dilution of the blood

It has therefore been advocated to give diluted Normal saline solution so that an uncomplicated case will receive only about seventy five grains of sodium chloride per day N/5 saline (*i e* Normal saline diluted to one fifth strength) is often the fluid of choice

In addition to this basic fluid allowance, Normal saline is given to replace salt lost in intestinal fluid For example if the patient has often vomited, Normal saline may be required

If the body chlorides are depleted there is a decreased excretion of chloride in the urine but unless the depletion is gross there is little change in the level of the chlorides in the circulating blood Thus the estimation of the level of the urinary chlorides is as important as the determination of the daily amount of urine

As a rule extra salt is only required if the urinary chlorides are diminished

Fantus has described a simple quantitative test for the amount of chloride in the urine but by itself it is only a very rough guide to the amount of chloride required It is described by Marriott —Ten drops of urine are measured into a test tube with a small pipette One drop of 20 per cent potassium chromate solution is added and then a 2 9 per cent solution of silver nitrate is added drop by drop and the test tube shaken after the addition of each drop The end point is a sudden change of colour from yellow to brown The same pipette must be used throughout so that the size of the drops is the same and the pipette must be rinsed with distilled water before it is used for each fluid The number of drops of the solution of silver nitrate required to obtain the end point, that is the sudden change in colour gives the concentration of chloride in the urine expressed as grammes of NaCl per litre Before use the chromate solution should be tested against distilled water to ensure that there is no contamination of it with chloride Normally the urine contains about five grammes of sodium chloride per litre

Potassium If there is a disturbance of the acid base mechanisms of the tissues and there is also a loss of sodium chloride (salt) some of the potassium of the cells passes into the extra cellular fluid and is eventually excreted in the urine Thus the stores of potassium in the body become depleted, and this depletion will be increased still further if there is vomiting, diarrhœa or continuous gastric or intestinal

aspiration The gastric and intestinal secretions contain a high percentage of potassium

The normal limits of the serum potassium are 16 4 to 20 4 mg per 100 ml (4 1 to 5 1 milli equivalents) If the level of the serum potassium is decreased (hypopotassæmia or hypokalæmia), there will be weakness of the muscles, dyspnœa abdominal distension, changes in the electrocardiogram, lethargy and eventually, delirium and cardiac failure

Potassium may be replaced by mouth or by intravenous infusion

If the patient is able to swallow and retain it potassium citrate or potassium chloride may be given by mouth in milk or fruit drinks in doses of 30 to 60 grains (2 to 4 Gm)

More often, however potassium replacement is required in patients who at that time are unable to absorb anything taken by mouth The potassium is therefore usually given by intravenous infusion, but as overdosage of potassium is very toxic to the heart, such intravenous infusions should be given slowly and then only to patients in whom the kidneys are functioning satisfactorily The rate and amount of potassium given by intravenous injection should be controlled by the clinical condition of the patient by frequent electrocardiograms, and by frequent estimations of the serum potassium level

Normally any increase in the serum potassium level is corrected by the excretion of potassium in the urine

The two solutions in common use for intravenous infusion, and which contain potassium are Ringer s solution and Darrow s solution

Ringer s solution contains many salts, including 0 22 gramme of potassium per litre but this is not sufficient for the correction of potassium deficiency

Darrow s solution contains sodium chloride, sodium lactate and potassium chloride and there are 2 7 grammes of potassium per litre This solution is preferably diluted before being given intra venously and even then it is only given in amounts of up to 500 ml at a time and it is run in at a rate such as 20 drops a minute

In a patient with a potassium deficiency the serum potassium level should be estimated at intervals until it has been returned to within normal limits

10 Urine After many operations especially those on the rectum, external genitalia and pelvic organs retention of urine frequently occurs

The patient should be told to pass urine some hours after the operation but if frequent attempts fail it may be necessary to resort to a catheter Catheterization should however, be avoided if possible owing to the danger of setting up a cystitis (inflammation of the bladder)

Many patients are unable to micturate whilst lying on their backs

Thus if the operation permits, the patient may be placed in a kneeling position, sat on the edge of the bed, sat on a commode or stood beside the bed The application of hot flannel compresses to the lower abdomen (or vulva) is also useful in some cases

Fifteen grains (1 Gm) of potassium acetate in half an ounce of water may be given every half hour up to eight doses, but it is more usual to try an intramuscular injection of either 1 0 to 2 0 ml of prostigmine (0 5 to 1 0 mg) or 0 25 mg of carbachol

If these measures fail, one or two catheterizations will suffice in most cases When catheterization has been necessary to relieve complete retention, the onset of spontaneous urination is by no means necessarily indicative of complete evacuation of the bladder contents In these cases catheterization is to be continued once daily after the patient has voided until no residual urine is found

Where a catheter is being passed repeatedly it is advisable to prescribe sulphacetamide (1 gramme t d s) as a prophylactic against cystitis and renal infection

If there is residual urine this must be measured and charted

If steps to ensure complete emptying of the bladder are not taken, the condition may progress to one of incomplete retention with or without resultant infection of the residual urine

11 Post operative Acidosis In spite of the constant production in the body of acids, either from metabolic processes or muscular action and the large quantities of alkali poured out during pancreatic secretion the chemical processes of the body are so regulated that under normal physiological conditions a constant acid base equilibrium is maintained

Post operative acidosis is a condition brought about by the excessive neutralization of bases in consequence of the formation of acids within the body

Vomiting is usually an initial symptom of impending acidosis It is associated with an unnatural drowsiness typical deep heavy gasping respirations (air hunger) great prostration and a sweet new mown hay odour in the breath The urine gives the characteristic reactions for acetone and diacetic acid

After certain anæsthetics there is a lowering of the alkali reserve Hence it is sometimes wise, more especially in connexion with operations on cases of obstructive jaundice urinary retention or thyrotoxicosis to give dextrose and alkalis particularly sodium bicarbonate for some days before operation so as to anticipate the post operative fall in the alkali reserve and to prevent if possible any acidosis

If vomiting is the cause of the acidosis, the treatment will be as described earlier in this chapter

12 Bowels After a few days many patients begin to complain of abdominal pains due to the collection of gas in the bowel A

rectal tube should be passed but, if this does not give relief, an enema may be indicated As long as the patient is comfortable it does not matter if the bowels do not act Those patients who are bowel conscious and worry if their bowels do not act daily should be reassured and should have the disadvantages of purgation explained to them

Formerly the meddlesome ritual of post operative purgation was widely practised

CHAPTER 16

HÆMORRHAGE

HÆMORRHAGE is defined as the escape of blood from a blood vessel It occurs after injury or operation

The hæmorrhage is said to be external if the wound by which the blood vessel is divided involves the skin and the blood escapes upon the surface of the body but if the blood flows into a cavity of the body such as the abdomen or the chest it is said to be an internal" or a concealed hæmorrhage

Hæmorrhage may be arterial' venous or capillary' according to whether the blood escapes from a divided artery, vein, or capillary

Arterial hæmorrhage has the following characteristics —The blood is bright scarlet in colour, it issues from the end of the vessel nearest the heart in spurts which correspond with each heart beat and pressure on the artery on the heart side of the wound will stop or diminish the flow Venous hæmorrhage differs in that the blood is dark blue in colour and flows in a steady oozing stream from the end of the vessel which is farthest from the heart On the other hand the blood in capillary hæmorrhage is red in colour and wells up from all parts of the wound in a continuous ooze

According to the time of its occurrence arterial hæmorrhage may be classified as primary reactionary or secondary

Primary hæmorrhage is said to take place when the bleeding begins immediately after the blood vessel is divided

Reactionary, recurrent or intermediate hæmorrhage occurs within the first twenty four hours after an injury or operation It is commonly due to the fact that the clot which seals the mouth of a divided vessel is not strong enough to withstand the increasing blood pressure following recovery from shock Occasionally it is due to the slipping or loosening of a ligature which has been poorly applied

Secondary hæmorrhage is usually due to infection of the wound and this may react in several ways the bacteria may digest the clot which was sealing the mouth of the divided vessel or they may cause ulceration of the vessel wall

Hæmorrhage from the external orifices of the body has been given distinctive names

Hæmoptysis, or spitting of blood denotes hæmorrhage from the air passages the blood is bright red in colour and, except in a very large quantity is frothy from the admixture of air

Hæmatemesis means the vomiting of blood Unless there is a very

large quantity of blood it is usually in the form of small clots which are brownish in colour and somewhat resemble coffee grounds, owing to the action of the gastric juice

Melæna is the passage of dark tarry blood with the stools and is evidence of injury or disease of the intestinal canal sufficiently high up to allow the blood to become altered by the action of the digestive juices Recent melæna is coal black, glistening and viscid, or, if it is mixed with the fluid of a rectal wash out, the latter is stained and black clots are seen floating in it It is necessary to distinguish this from a dark motion due to old melæna or drugs

Epistaxis is a term given to bleeding from the nose, and **Hæmaturia** to blood in the urine

Symptoms and Signs of Hæmorrhage The symptoms of hæmorrhage fall into two groups the local and the general

THE LOCAL SYMPTOMS vary according to the site and time of the hæmorrhage, whether it be external or concealed If the wound involves the skin the blood will generally be visible, as it also is with bleeding from the lungs kidney nose bowel, etc

On the other hand hæmorrhage into one of the serous cavities of the body is usually not visible, but it excites inflammation of that cavity and thus causes local symptoms Hæmorrhage from the respiratory tract is apt to induce asphyxia and later is very liable to lead to broncho pneumonia

THE GENERAL SYMPTOMS which arise from loss of blood are the same whether the hæmorrhage is internal or external and they depend as much on the rapidity of the bleeding as on the total amount of blood lost As the bleeding progresses the pallor increases and the lips ears and eyelids become ashen

Owing to the deficiency of blood the tissues suffer from want of oxygen and the patient feels as if he is being suffocated, he grows extremely restless tossing about in bed and appealing for more air (air hunger) for the window to be opened etc Deficiency of blood in the brain causes fainting attacks noises in the ears, and temporary or even permanent loss of sight The pulse rate steadily rises the volume is more or less maintained whilst the pulse collapses entirely between the beats This phenomenon is due to the passage of a small amount of blood through a vessel which is practically empty

The patient enters into a condition of severe collapse, the blood pressure falls, thirst becomes intense the extremities cold and the temperature subnormal The respirations become quicker and deeper, in the nature of sighs and soon the patient gasps for air Finally the pulse fails altogether and unconsciousness and death ensue

There is a certain resemblance between shock and hæmorrhage, so it is well to compare the individual signs of these two conditions when following an operation

Shock	Hæmorrhage
1 *Signs* date *from the operation*	1 Signs develop after operation or injury
2 Signs tend to improve gradually	2 Signs tend to develop
3 Local symptoms absent	3 Local symptoms often present *e g* pain and tenderness
4 Pallor moderate	4 Pallor very marked especially of *mucous membranes*
5 Pulse rapid and weak	5 Pulse more and more rapid and collapsible
6 Respirations rapid and shallow	6 Respirations sighing
7 Mentality dull and stuporous	7 Mentality active
8 Patient quiet	8 Patient extremely restless
9 Patient does not feel faint	9 Patient always feels faint
10 Sweating usually present	10 Sweating usually absent
11 Stimulants ameliorate shock	11 Stimulants increase hæmorrhage

Estimation of the Severity of a Hæmorrhage It was formerly the custom in cases of concealed or internal hæmorrhage to make repeated examinations of both blood pressure and hæmoglobin percentage in order that the degree of such hæmorrhage might be estimated and any recurrence noted That this may be inaccurate is shown graphically in Fig 209

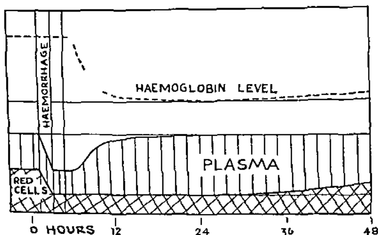


FIG 209 Chart showing the effects of a sudden hæmorrhage on the hæmoglobin level on the volume of the plasma and on the volume of the total red cells

Immediately after the hæmorrhage the *percentage* of hæmoglobin in the blood is unchanged but as the blood volume is returned to normal by an increase in the plasma the percentage of the hæmoglobin falls Later as the red cells are replaced the percentage of hæmoglobin gradually rises again

The estimation of both blood volume and plasma volume eliminates the error of delayed blood dilution for example a sudden loss of half the total blood volume would show no immediate fall in the hæmoglobin percentage whilst a blood volume estimation would at once indicate the extent of the loss

The Natural Arrest of Hæmorrhage In the natural arrest of hæmorrhage two stages can be recognized the stoppage of the hæmorrhage and the formation of a scar

Hæmorrhage from a vessel is arrested by the cut or torn coats behaving in a characteristic manner and by the blood coagulating in and around the torn vessel After the injury the outer fibrous coat connecting the vessel with the surrounding tissues is left bare owing to the inner and middle coat retracting within its lumen The middle or muscular coat contracts owing to the stimulus of the injury and further diminishes the lumen of the tube whilst the inner elastic coat curls up and retracts within the lumen of the muscular coat (Fig. 210)

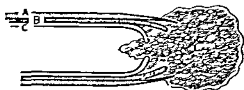


Fig 210 Diagram showing a blood vessel blocked by a blood clot and the inturning of its walls In this manner hæmorrhage is arrested naturally

A Outer fibrous coat of the vessel *B* Middle muscular coat and *C* Inner elastic coat and lining of endothelium.

Blood clot forms in the mouth of the vessel thereby narrowed, in the lumen of the vessel up to its nearest branch and also round the mouth of the vessel Hence the hæmorrhage is now temporarily arrested owing to the contraction of the mouth of the vessel and to plugging of the lumen with blood clot

Clotting of the blood may be aided by various hæmostatic substances

Normally blood clots by the reaction of thrombin with fibrinogen to form fibrin For this reaction to occur the thrombin must first be formed thus clotting may be accelerated if extra thrombin is applied to the wound Thrombin is not suitable for injection

Other types of hæmostatic agents include absorbable oxidized cellulose (Oxycel Parke Davis & Co) and absorbable gelatin sponge (Sterile Gelatin Sponge Allen & Hanburys and Gelfoam The Upjohn Co) These are applied to the bleeding site to which they adhere accelerate clotting and block the vessels later they are absorbed.

As a result of trauma a certain amount of inflammation occurs and masses of small round cells accumulate in the neighbourhood of the bleeding point. Now as in the case of healing of a wound by first intention, these round cells invade the blood clot and then turn into spindle cells which produce young fibrous tissue The ultimate result is that the vessel, up to its nearest branch, is completely

obliterated in the fibrous tissue which goes to heal the wound and unite the two cut surfaces

Treatment

TREATMENT OF ARTERIAL HÆMORRHAGE *Primary Hæmorrhage* In the diagnosis and treatment of hæmorrhage a great responsibility may fall upon the nurse for not only has she the opportunity of being the first to recognize the condition but sometimes she must deal with it immediately

After all operations hæmorrhage must be carefully watched for and its occurrence must at once be reported to the surgeon Failure to make such a report when the bleeding begins may result in the patient s death

In the temporary arrest of hæmorrhage the main points are — First, position, and second pressure The position of an injured part has a considerable influence on the bleeding for it is obvious that hæmorrhage will occur more freely from a dependent limb than from one which is raised above the level of the heart

Pressure in the form of digital compression tourniquets etc , will produce cessation of the bleeding independently of the posture By digital pressure is meant the arrest of hæmorrhage by the application of a finger or thumb directly to the bleeding point or to the artery running to the injured surface *i e* the artery on the side of the wound nearest the heart

Owing to the risk of infecting the wound by unclean fingers it is advisable to apply pressure to the artery and not to the wound and care must be taken to compress the artery against some bone rather than against the soft parts This may be carried out with the fingers or by means of a tourniquet

A tourniquet consists essentially of a band which encircles the limb, and a tightening arrangement whereby the band may be sufficiently tightened to arrest the circulation in the main artery leading to the wound A pad over the artery adds to the efficiency of the apparatus and should always be used where possible Two special tourniquets in use are Esmarch s tourniquet and the anchor or Samway s tourniquet

(i) *Esmarch s Tourniquet* consists of a piece of elastic tubing to one end of which a hook is fixed and to the other a short chain The elastic tubing is firmly wound two or three times round the limb and the hook is then fixed in one of the links of the chain

(ii) *The Anchor or Samway s Tourniquet* is composed of a stout piece of elastic tubing with a piece of metal shaped like an anchor at one end The tubing is wound two or three times round the limb and finally fixed by carrying it round the shank and under the two flukes of the anchor

More usually a simple piece of rubber tubing is used and after

it is tightened, it is fixed by passing one end over and under the rest of it

For operations on a limb an Esmarch s bandage is often used as a tourniquet This consists of a rubber bandage about 2½ inches wide It is tightly applied from the lower end of the limb to the upper where it is fixed and then the lower part of the bandage is unwound till the operation site is sufficiently exposed (Fig 335)

The pneumatic band of the sphygmomanometer makes a very efficient tourniquet, the degree of pressure can be controlled, and it is not likely to damage nerves

All forms of hæmorrhage, however severe, can be temporarily arrested by the above means until preparation can be made to control the bleeding more efficiently

A tourniquet on the screw or windlass principle may be readily improvised

A large handkerchief is loosely but securely fastened round the limb with a reef knot A pad is made by a rounded stone, a knotted up handkerchief or a roller bandage, etc , and this is placed under the handkerchief and over the line of the artery A stick is then passed under the encircling handkerchief and twisted round several times until the pad is pressed on the artery with sufficient force to arrest the bleeding when the end of the stick is secured with a second bandage to prevent its untwisting

Before applying a mechanical tourniquet the skin at the site of application should be protected by wrapping a handkerchief, piece of lint or a few turns of a roller bandage round the limb

Arresting hæmorrhage by means of a tourniquet is not devoid of danger for if the tourniquet is applied too tightly or left on too long (more than 20 minutes at a time) gangrene of the limb distal to the constriction may occur On the other hand if the tourniquet is not applied tightly enough the bleeding may be increased as the veins and not the arteries are compressed

Permanent arrest of hæmorrhage should proceed in three stages Firstly the bleeding must be stopped by picking up with artery forceps both ends of the bleeding vessel and ligating them thus ensuring that the ends will remain closed until they are plugged with firm clot secondly the wound must be dressed thirdly, the injured part should be firmly fixed in an elevated position so as to ensure complete rest

It should however be borne in mind that stimulants should not be given in cases of collapse associated with hæmorrhage, until the bleeding vessel is controlled

Patients who have suffered from a severe hæmorrhage are usually anæmic Iron should be given and perhaps further transfusions will be required The diet should be full and should contain liver and kidneys

Reactionary Hæmorrhage The methods of arresting reactionary hæmorrhage are similar to those used for primary hæmorrhage

After the bleeding has been checked temporarily, the patient is prepared for operation, as the best treatment, when it can be carried out is to reopen the wound and ligate or oversew the bleeding vessel In the case of deep wounds pressure has occasionally to be exerted upon the bleeding point by plugging the wounds with gauze In rare instances recourse must be had to escharotics and styptics of various kinds, of which the actual cautery is the most potent

Secondary Hæmorrhage The treatment of secondary hæmorrhage differs in that no matter how slight the bleeding the artery must be firmly secured as a small hæmorrhage may be the precursor of a fatal one This red warning " should never be disregarded, the patient s blood group should be determined and every preparation made for what may be a copious hæmorrhage in the next few hours

Secondary hæmorrhage usually results from septic inflammation of an artery and does not occur in aseptic wounds

If secondary hæmorrhage is expected the patient must be constantly watched and a tourniquet must be at hand for immediate application It is treated by reopening the wound ligating or understitching the vessel inserting a drain tube if necessary and removing any pus or sloughs If these methods fail recourse may be had to the actual cautery or to packing the wound with sterile gauze

Internal Hæmorrhage Internal hæmorrhage is generally recognized by the symptoms of syncope and collapse with the general signs of hæmorrhage Where the hæmorrhage is large fever and slight jaundice may follow owing to the absorption of some of the con stituents of the blood

Until the arrival of the surgeon the patient should be kept recumbent and the end of the bed raised but if the collapse is severe the limbs should be firmly bandaged, and a tight binder may be applied to the abdomen

The best treatment for internal hæmorrhage is to operate, secure the bleeding point and ligate it The extreme circulatory collapse so commonly seen in subjects of massive intra abdominal hæmorrhage is clearly due to rapid depletion of blood volume and inadequate replacement from the tissue fluid Hence instead of the patient being hurried direct from the ambulance to the operating theatre it is sometimes necessary to spend time replacing the blood by transfusion in order to counteract the collapse Operation can then be undertaken with a greatly increased chance of a smooth convalescence

If the surroundings are unsuitable for operative interference, or if the source of the hæmorrhage cannot be dealt with, ice should be

applied over the probably source of the bleeding The patient should be kept as quiet as possible and morphia administered hypodermically

Sites of Compression for the Temporary Arrest of Arterial Hæmorrhage

Arm For hæmorrhage from the arm or forearm the fingers are applied on the inner side of the middle of the upper arm and pressure applied outwards and backwards so as to compress the brachial artery against the humerus

If the source of bleeding is nearer the shoulder joint, the subclavian artery may be compressed by applying the thumb just above and behind the centre of the clavicle and pressing from above downwards on to the first rib

Leg To control hæmorrhage from the lower limb until a tourniquet can be applied the femoral artery just below Poupart s ligament should be compressed with both thumbs against the pubic bone The pressure should be applied midway between the symphysis pubis and the anterior superior iliac spine and directly backwards against the brim of the pelvis

TREATMENT OF VENOUS HÆMORRHAGE Venous hæmorrhage occurs most frequently in association with varicose veins of the leg, in this condition the veins of the leg become distended and the valves are rendered incompetent

When venous hæmorrhage occurs the patient should be placed in the recumbent position the wound exposed and any constriction such as tight bandages or garters on the heart side of the wound removed Digital pressure is applied to the wound until a pad and firm bandage are in place and then the part is elevated *A tourniquet should not be applied*

If later on blood should begin to ooze from beneath the pad, a firmer bandage should be applied immediately

TREATMENT OF CAPILLARY HÆMORRHAGE Capillary hæmorrhage can be arrested by applying firm pressure over the bleeding spot by means of a pad of gauze covered by a firm bandage The gauze may first be impregnated with various drugs known as styptics or hæmo statics which arrest hæmorrhage either by aiding coagulation or by causing marked contraction of the blood vessels The most powerful of these are *thrombin* and *adrenalin* which latter is usually supplied in the strength of 1 in 1 000 Others used to arrest hæmorrhage are ferric chloride and calcium chloride

Nowadays if the bleeding is troublesome the pad would be usually applied over a piece of Oxycel or Gelatin Sponge

TREATMENT OF CERTAIN SPECIAL HÆMORRHAGES *Epistaxis*, or bleeding from the nose is sometimes rather difficult to arrest The patient, who should be sitting erect and not lying in the recumbent

position, should have his face and neck bathed with cold water and may be allowed gently to sniff air through the affected nostril

If this fails, the cavity of the nose may be packed with long strips of ribbon gauze, either dry or soaked with adrenalin solution Instead a finger stall may be wrapped with Oxycel gauze and inserted into the nose Pressure of the Oxycel on the bleeding point is then obtained by packing the finger stall tightly with gauze (See also page 556)

Hæmorrhage after the Extraction of Teeth is sometimes troublesome The tooth socket should be plugged from the bottom with sterile gauze which is covered by a pad of folded lint sufficiently thick so that the teeth will not meet The patient then closes his jaws and firm pressure is maintained by means of a jaw bandage If this fails a styptic such as Liquor Ferri Perchloridi is applied to the socket or a piece of Oxycel gauze is inserted Pressure is then applied by biting onto a small pad

Hæmoptysis may be mistaken for hæmatemesis, but the following table indicates the main differences between the two conditions

Hæmoptysis	Hæmatemesis
1 Blood frothy	1 Blood not frothy
2 Bright red colour	2 Dark brown colour
3 No clots	3 There may be clots
4 Mixed with phlegm	4 Mixed with food
5 Coughed up in mouthfuls	5 Vomited up
6 Symptoms relate to the chest	6 Symptoms relate to the stomach

The patient should be kept quiet in the recumbent position and medical aid obtained A hypodermic injection of morphia is usually ordered to allay the cough and an ice bag may be applied to the affected side of the chest

With the exception of ice to suck it is as well not to disturb the patient with food for some hours after the hæmorrhage has ceased

Hæmatemesis The treatment is practically identical with that just described for hæmoptysis *viz* —complete rest in the recumbent position, an ice bag to the pit of the stomach a hypodermic injection of morphia and the prohibition of all food by mouth Small pieces of ice may be given to be sucked but it is doubtful if this does any good

In cases of more severe hæmorrhage a combination of remedies may be tried thus 20 to 30 ml of normal horse serum may be injected into the buttocks morphia administered hypodermically and 5 ml of calcium chloride (10 per cent) given intravenously In addition these methods should be supplemented by a blood transfusion

In some cases of bleeding from the stomach or duodenum there is no hæmatemesis, melæna occurs later

Scalp Wounds are common in hospital practice and usually bleed freely The edges of the wound should be opposed (with sutures if necessary) and pressure applied by means of an antiseptic pad and

dressing bandaged firmly over the cranium This will usually be found sufficient to arrest the hæmorrhage

Hæmorrhage from Incisions into Inflamed Tissues Incisions into inflamed tissues often bleed profusely They may require packing with strips of gauze and firm pressure should be applied by means of cotton wool and bandages The limb should be elevated and the gauze kept *in situ* for twenty four hours

Leech Bites occasionally give trouble and should cold and pressure fail to arrest the bleeding each wound may be touched with a fine pointed stick of silver nitrate

Hæmorrhage due to Constitutional Disturbance In certain con ditions the patient bleeds long and freely on the slightest provocation *Such hæmorrhage is usually capillary in type, but a considerable* quantity of blood can be lost by the continual oozing

The intractability of the bleeding is usually due to a defect in the chemical composition of the blood which manifests itself clinically by a defective clotting capacity This defect may however, be temporarily rectified by the transfusion of blood from a suitable donor

This type of hæmorrhage is most commonly met with in hæmophilia, jaundice and leukæmia

Hæmophilia *is a hereditary disease, transmitted by the female* but limited to the male sex in which small cuts, etc, are followed by continuous oozing which is frequently dangerous This disability persists throughout life

In hæmophiliacs the vessels are normal but there is an inherited deficiency in the serum of one of the globulins (AHG) As a result the *coagulation time* is greatly prolonged

The most effective agent both for treatment and pre operative *prophylaxis is transfusion of fresh blood*

For immediate treatment pressure packing and styptics are usually employed

Jaundice *Capillary oozing from the wound and even from the* stitch holes is very likely to occur in patients suffering from severe jaundice

It has now been established that the cause of this hæmorrhagic tendency is a deficiency of prothrombin which in turn originates through a failure of absorption or utilization of vitamin K This tendency to bleed does not supervene until the prothrombin level falls to approximately 20 per cent of the normal

Quick s method for the determination of *prothrombin clotting time* has proved to be a valuable aid in the detection of this condition

Theoretically 20 mg of vitamin K should be an adequate daily dose for an adult man but ten times this dosage has been commonly administered for the control of hæmorrhage in severe jaundice

Bile salts act as the carrier for fat soluble vitamins from the intestine

Accordingly vitamin K by mouth will not improve the prothrombin clotting time unless bile is present in the intestinal tract or the vitamin is administered in combination with bile salts

Blood normally contains a great excess of prothrombin (approximately five times the amount necessary for coagulation) hence blood transfusions may be used as an alternative method for the control of hæmorrhage when vitamin K is not available

More recently the chemical analogue of vitamin K, methyl naphtho quinone has been available for intramuscular injection Another analogue is available for intravenous injection and is indicated when it is urgently necessary to restore a low prothrombin level On the other hand there seems to be no point in the indiscriminate use of vitamin K or of its analogues in cases of hæmorrhage due to causes other than a deficiency of prothrombin

If bleeding occurs from a wound in a jaundiced patient, the wound should be packed with gauze soaked in thrombin or adrenalin and firm pressure applied

LEUKÆMIA is another disease in which similar oozing occurs The treatment is by transfusion and local measures

AFIBRINOGENÆMIA or FIBRINOGENOPENIA may be congenital or acquired (due to liver disease and child birth) In this condition the blood does not clot, but it is relieved by the use of fibrinogen Fibrinogen which is obtained from the blood of a donor is usually supplied in 1 gramme amounts of the dried material This is dissolved when required, in 25 ml of Normal saline and is then given intravenously Fibrinogen is the protein from which the fibrin of a blood clot is formed The normal blood level is 0 22 to 0 36 Gm per 100 ml

In addition to defects in the chemical composition of the blood, intractability of the bleeding may be due either to increased fragility of the capillaries (PURPURA HÆMORRHAGICA) or to a decrease in the number of platelets in the circulating blood (THROMBOCYTOPENIC PURPURA) One result of a deficiency of platelets is prolonged bleeding from small puncture wounds due to the inability to form aggregations of platelets which would block the wound The *bleeding time* after a needle puncture of an ear lobe is therefore prolonged in these patients

BONE MARROW BIOPSY

Occasionally the surgeon is requested to obtain a specimen of the bone marrow to help with the diagnosis in obscure hæmatological cases The sternum is the site usually chosen for that procedure but sometimes the tibia is used in small children

The methods used are —

1 Puncture and aspiration and
2 Trephination

With both methods a local anæsthetic is usually used

Following a sternal puncture the aspirated bone marrow is spread on specially cleaned, new glass slides in the same way as blood films are spread



FIG 211 Witt s modification of Salah s sternal puncture needle with adjustable stop

After the removal of the disc of bone and of bone marrow by trephination the specimen is placed in a solution such as Zenker's solution with acetic acid, for fixation but before the wound is closed some of the bone marrow may be aspirated and slides made as above The trephine used here is about 5 mm in diameter

Very strict asepsis is imperative with bone marrow biopsies as infection may lead to an osteomyelitis Also the patients on whom this manœuvre is performed are often in a debilitated state and have a poor resistance to infection

CHAPTER 17

SHOCK AND ALLIED CONDITIONS

PHYSIOLOGY OF BLOOD PRESSURE

AN adequate quantity of circulating fluid is essential for the maintenance of an efficient blood pressure Such pressure can be equally well maintained by any fluid of such an osmotic pressure and viscosity that it is retained in the cardiovascular system

THE VITAL FUNCTIONS of the blood comprise

Carriage of oxygen through the agency of the hæmoglobin of the living red blood corpuscles

Removal of carbon dioxide from the tissues and its transport to the lungs

Carriage of food substances, *e g* glucose amino acids and fats to the tissues and the carriage of waste products to the liver and kidneys

Mobilization of the defences of the body (for example leucocytes antitoxins agglutinins opsonins etc) developed as a response to attack by noxious substances or organisms

In health the normal pressure and velocity of the blood are maintained by three factors —the work done by the heart, the resistance produced by contraction of the peripheral arterioles, and the volume of the circulating blood It is by means of this mechanism that the cells of the body are supplied with their vital constituents and are able to carry out their functions On the other hand if the tissues are deprived of their blood supply for a period, harmful metabolic changes occur and irreparable damage may result The length of time necessary to produce such results varies with the different tissues, but in the brain and spinal cord the deprivation of oxygen produces permanent changes in a few minutes

The muscle coat of the arteries is supplied by nerves which transmit impulses from the vasomotor centre in the medulla Stimulation of these nerves produces a narrowing of the arteries and hence a rise in blood pressure On the other hand, paralysis or cutting of these nerves causes a dilatation of the arteries and a consequent fall in blood pressure In other words alterations in the blood pressure may be caused by variations in the sizes of the peripheral arteries Following stimulation of an afferent or sensory nerve, an abrupt fall in blood pressure occurs due to inhibition of the vasomotor centre in the medulla, and a condition of syncope is produced

Crushing injuries are associated with considerable losses of blood and fluid in the tissues, and it has been shown that such loss may be sufficient to account for the fall in blood pressure apart from any absorption of the crush products

As the blood pressure falls the circulation is lessened and the supply of oxygen to different parts of the body is diminished It is not so much that the blood is insufficiently oxygenated, as that it is not supplied to the tissues with sufficient rapidity owing to the low blood pressure This defective supply of oxygen leads to degenerative changes of various kinds in the tissues, and especially in highly sensitive structures such as the nerve centres Thus, although in the early stages of shock the low blood pressure is associated with constriction of the arterioles in the later stages the arterioles may be relaxed by such damage to the vasomotor centre in the medulla that it no longer holds the arterioles in tonic contraction

This vicious circle must be broken, the most effective way being to raise the blood volume by increasing the fluid in the circulation thus ensuring a better supply of oxygen to the tissues

During the course of an operation the intensity of shock may be gauged by taking frequent readings of the pulse rate and blood pressure

SHOCK

Definition Shock is that depressed activity of bodily functions following upon severe injury (either wounds or surgical operations) It is due to oligæmia that is a temporary lessening of the volume of the circulating blood It is not necessarily associated with a loss of blood from the body

Theories As to the primary cause of the oligæmia, whether it is due to the action of some chemical product of tissue injury to painful or other stimuli producing molecular changes in the nervous system or to loss of blood into the injured part it is impossible to decide It would be rash to argue that nervous impulses play no part in the production of shock indeed there are cases in which a pure nervous shock from trivial wounds seems to be present Crile demonstrated alterations in the nerve cells of tissues taken from shocked animals and argued that shock is of nervous origin The stimuli producing such changes may be of two kinds —

TRAUMATIC caused by the injury done to the tissues by cutting instruments etc as well as by the various manipulations which form part of every operation

EMOTIONAL caused by the fear of the operation anæsthetic, etc

In shock, four vital processes are notably depressed the temperature is subnormal there is a considerable fall in blood pressure the pulse is weak rapid and easily compressible and the respirations are shallow and irregular

The autopsy findings are more or less characteristic The veins are flaccid and half empty the heart contains but little blood whilst the left ventricle is frequently in a state of tonic contraction and the arteries, both large and small appear to be constricted rather than dilated and similarly contain but little blood A characteristic feature is the general pallor of the viscera, especially of the intestines and omentum

The liver is moderately pale and not distended with blood, and the same is true of the lungs, spleen and kidneys

It therefore follows that the missing or lost blood is not concealed in the heart arteries or large veins furthermore no large part of it has accumulated in the liver or spleen The only possible explanation of this relative insufficiency is capillary dilatation, the patient, as it were, bleeding into some of his own capillaries

In short during shock the cutaneous and splanchnic capillaries are constricted whilst those of the skeletal muscles are dilated and the blood stagnates in them

The blood pressure consequently falls and the blood vessels of the rest of the body, particularly the peripheral arteries and veins become constricted in an effort to maintain the normal pressure Owing to tissue asphyxiation abnormal permeability of the walls of the dilated capillaries then develops and an increased amount of blood plasma passes out of the circulation into the tissues with the result that the blood is concentrated and the effective blood volume is further diminished

It is particularly to be noted that owing to the generalized vaso-constriction present no fall in the blood pressure becomes manifest until the blood volume has been reduced to a considerable degree Hence the customary estimation of blood pressure must be an unreliable guide wherewith to estimate the degree of shock in its early stages There is however an early increase in both blood viscosity and hæmo concentration due to a loss of plasma without any loss of the formed elements (corpuscles)

Varieties PRIMARY OR NERVOUS SHOCK occurs immediately on receipt of an injury It is chiefly due to reflex inhibition of the vasomotor centre As this centre causes the blood vessels of the body to be maintained in a state of partial contraction it follows that any interference with the centre or its efferent pathways to the blood vessels must lead to vasodilation and a fall in blood pressure

Not only may the centre be definitely inhibited by afferent impulses whether they are of peripheral or psychic origin but it may be temporarily thrown out of action by concussion of the brain This variety of shock is enhanced by fear emotion and cold reduced by morphia and preventable by deep anæsthesia

SECONDARY SHOCK occurs in its typical form after severe burns and

when large masses of tissue are destroyed, the patients going into shock, not immediately, but after several hours This variety is aggravated by cold and anæsthetics

Factors Influencing Shock There are certain injurious factors which tend to lower blood pressure but are not necessarily serious, unless combined with a loss of blood volume

THE OPERATION In all operations the amount of shock varies in accordance with three factors —

Firstly the part operated on The more specialized and abundant the nerve supply of the part, the greater is the shock

Secondly the mass of tissue involved Operations or wounds involving injury of large masses of muscular tissue are especially liable to produce shock

Thirdly the nature of the operation The amount of shock depends on the length of the operation and the amount of manipulation necessary skilful treatment and the use of sharp instruments damage the tissues less and there is less shock

ANÆSTHETICS It is of the greatest importance that during anæs thesia cyanosis should not be allowed to occur as the body tissues are then exposed to all the evil effects of diminished oxygen supply

Excess of carbon dioxide can be caused in many ways amongst which are obstructed respiration improper ventilation during any anæsthetic and failure to replace the soda lime in the gas machine

The initial effect of an excess of carbon dioxide is to cause a rise in the blood pressure by stimulation of the vasomotor centre but if this excess of carbon dioxide is permitted to continue it will have an injurious effect on the heart a pronounced fall in the blood pressure will follow and dilatation of the peripheral blood vessels will occur

Furthermore certain anæsthetics are toxic in their action and are contributory causes in the production of shock In normal individuals, ether during the course of its administration induces a rise in blood pressure while chloroform causes a steady fall

On the other hand patients suffering from shock become more sensitive to ether and chloroform both of which may induce a danger-ous reduction of an already low blood pressure Fortunately these patients tolerate cyclopropane and oxygen without any further fall of blood pressure With this form of anæsthesia there is an absence of the usual after effects such as vomiting sweating etc the patient is soon awake and can be given fluids by mouth

Too light anæsthesia of any type during operation will cause or increase shock

LOSS OF BLOOD AND OTHER BODY FLUIDS As the symptoms are due to a deficiency in the volume of the blood in circulation it follows that a condition of shock is more likely to be brought about when the loss of blood is great

PREPARATION FOR OPERATION The mental condition of the patient has much to do with the severity of shock and cases are recorded where patients have died of shock before the operation commenced The patient should be reassured sedatives given, and all preparations should be made quickly and quietly, and as much as possible out of the sight of the patient Drastic purgatives must not be used in preparing the patient as they produce a temporary watery diarrhœa which tends to cause a fall in blood pressure

Diet Food and fluids should not be withheld for more than a few hours before operation, otherwise the tendency to shock will be increased However, if there is obstruction of the gastro intestinal tract no useful purpose will be served by overloading it with food or fluids

Clinical Signs FALLING BLOOD PRESSURE At first an attempt is made to maintain the blood pressure by an increased rate of the heart beat later it falls The systolic pressure is occasionally depressed below 100 millimetres by severe operations and anything below 70 millimetres signifies grave danger

THE PULSE The pulse is weak, rapid and easily compressible in severe shock it rises to 140 above which it is difficult to count

THE SKIN The skin is pale and clammy It feels cold owing to the constriction of the cutaneous vessels Sweating is a marked feature

TEMPERATURE The temperature falls to 97° or 96° Fahr, chiefly because of the profuse sweating

RESPIRATIONS are superficial shallow and irregular

CEREBRAL PROCESSES The mental faculties are diminished and in severe shock the patient is semi conscious

THE MUSCLES These are relaxed and muscular movement is markedly restricted The reflexes are decreased

FACIAL EXPRESSION The face appears shrunken and pinched and the features are elongated owing to the drooping chin There is remarkable languor in the expression, the eyes lose their lustre and lie deep in their sockets surrounded by a dusky ring, the eyes are half closed and the lips are thin parched and pale This facies is brought about by two factors first the muscular relaxation, which causes the elongated features sunken eyes and drooping eyelids and second, the deficient blood pressure which gives the anæmic pallor and the lustre less eyes In children we sometimes find shock accompanied by great restlessness

Treatment Shock is only a temporary condition and given time every patient would recover but unfortunately the patient may succumb before the volume and concentration of the blood have time to return to normal Therefore in severe cases the aim should be to keep the patient alive by increasing the volume of the circulating blood until such time as the capillary walls recover We shall first discuss a mild

case of shock and then enumerate the various restorative methods that may be used in addition in cases of severe shock

TREATMENT OF MILD CASES *Rest* The patient must be kept quiet and not allowed to expend any unnecessary energy Even slight movements cause a further fall in the blood pressure

Warmth Cold alone is not a cause of shock, but we must supply warmth in moderation in order to spare the bodily energy Heating must not be overdone for, if the patient is hot, sweating and dilatation of the superficial blood vessels occur and these will aid in keeping down the blood pressure

A warm skin may transfer perhaps half a litre of blood from more vital organs where it is so urgently needed It follows therefore that, when the temperature is reduced use of a heating cradle will be indicated, but the temperature must be carefully checked at frequent intervals by means of a rectal thermometer

In certain operations, *e g* repair of a defective septum in the heart, it is sometimes necessary to use refrigeration anæsthesia, *i e* the body is cooled under general anæsthesia to not less than 83° Fahr (28 5° Cent) In these cases the muscles are kept relaxed to avoid shivering for that would exhaust the patient

Fluids If possible the patient should be given hot liquids by mouth

Morphia Anæsthetics decrease the amount of shock by decreasing the incoming pain impulses to the brain But as the effect of the anæsthetic passes off the pain of the wound may become appreciated, *and if severe, will increase the shock Hence morphia is very valuable* not only as a relief from pain but also as a preventive of shock

In the advanced degrees of shock, the administration of morphia is unsound because the concomitant depression of the respiratory centre is liable to increase the oxygen deficiency of the blood and to increase the permeability of the capillaries

Oxygen The inhalation of warmed oxygen has a definite amelior atory effect in cases of moderate shock A mask such as the oronasal type of the B L B mask and a nasal catheter are efficient and economical methods of oxygen administration

An oxygen flow through a mask varying between four and eight litres per minute will give 100 per cent oxygenation according to the age sex and weight of the patient

The same rates of flow through a nasal catheter will give 50 per cent oxygen provided the catheter is correctly placed

TREATMENT OF SEVERE CASES As has been stated before, shock is a temporary condition and when the above treatment is not satis factory various methods of stimulation must be applied in order to keep the patient alive The chief of these are —

Drugs acting directly on the Muscle Coat of the Arteries Adrenalin, noradrenaline pituitary extract Neo Synephrine Methedrine,

ephedrine, and ergotoxine These drugs act on the arteries directly and cause their contraction, the peripheral resistance being thus increased, the same force of heart beat as before produces a rise of blood pressure This rise however, is more or less counteracted in any particular organ by the constriction of the arterioles for this limits the velocity of the blood supply to that organ As the arteries are already contracted, the evidence is strong that no good object is served by causing an increase in this contraction Furthermore although adrenalin causes constriction of the cutaneous and splanchnic blood vessels it has the serious disadvantage that it induces a dilatation of the capillaries of the skeletal muscles

Of the above drugs Neo Synephrine and Methedrine in repeated doses of ½ to ¾ ml are probably the most useful clinically

Mechanical Stimulants to raise the Blood Pressure By raising the foot of the bed, blood is tilted out of the abdominal vessels to the heart and brain This position is also useful as it aids in the retention and absorption of fluids given per rectum It is however impracticable in cases of heart and lung disease

By bandaging the limbs blood is displaced from the limbs to the trunk, and this may help raise the blood pressure

Raising the Blood Pressure by the Injection of Fluids By increasing the volume of the circulating blood, the blood pressure is raised without altering the peripheral resistance, and a better supply of blood to the organs and especially to the cerebral centres is ensured

Normal Saline Solution In the past this was introduced into the body by various routes, intravenously subcutaneously, intra peritoneally, and per rectum, but the clinical results in shock were most unsatisfactory

Glucose Intravenous injection of two to three ounces of a 50 per cent solution of glucose will raise the blood pressure 15 to 50 millimetres and completely change the patient s appearance within four or five minutes, but the effect is only transient

Dextran This is a colloid solution which produces a slightly more prolonged rise in the blood pressure after intravenous injection than do saline and glucose, thus it is of some value in an emergency if blood or serum or albumin is not available

Serum Albumin Albumin is one of the proteins occurring naturally in the serum Albumin is supplied as a 25 per cent solution in bottles containing 100 ml It has the advantages of not causing serum jaundice and of keeping indefinitely It is best stored at a temperature between 2 and 10° Cent but it should not be frozen

Albumin is used for intravenous injection in cases of shock, burns, and hypoproteinæmia but it is of special value in an emergency when there is a depleted circulating blood volume and at any time in cases of shock without blood loss

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intervention of any compatibility tests and the fact that it may be kept in liquid form at 4° C for several months Also, plasma is of value in cases of burns where there is hæmoconcentration due to a greater loss of fluid than formed elements from the blood stream

Against that the failure to replace the formed elements of the blood is one of the chief disadvantages of plasma in many conditions The other main disadvantage is that it is possible to transmit infectious hepatitis or homologous serum jaundice by the use of infected plasma (or serum)

Owing to the high viscosity of the blood in secondary shock a plasma transfusion by gravity alone is often difficult and some form of *pressure system is advisable*

If the patient is restless and complains of pain in the loins following the administration of blood or plasma the urine should be tested at regular intervals for the presence of hæmoglobin as this indicates some degree of incompatibility of the blood If the urine is kept alkaline hæmoglobin is less likely to be precipitated in the kidneys and block the renal tubules in a patient suffering from hæmoglobinuria

In mild cases drachm doses of either sodium citrate or sodium bicarbonate hourly by mouth will probably serve to render the urine alkaline but in more severe cases, when over 150 ml of blood has been administered, an intravenous injection of a litre of 0 3 per cent sodium bicarbonate solution or 200 ml of a 3 8 per cent solution of sodium citrate may be substituted

Plasma may also be reduced to a *dry powder by desiccation* each 100 ml of citrated plasma yielding approximately 8 grammes (124 gr) of dried plasma In this form plasma can be kept for an indefinite period and may be readily prepared for use by regeneration with warm sterile distilled water

Treatment of severe shock must not be delayed since if the shock has been very profound for more than a few minutes the vasomotor and other vital centres may be irreparably injured no matter what treatment is employed afterwards

In a hospital in which many accidents are received at least one shock bed should be kept *ready for a severely shocked case* It should be in the resuscitation ward Two sets of warm blankets, electric bed cradle high blocks to elevate the foot of the bed, fracture boards transfusion and blood typing apparatus serum albumin, plasma and blood should all be readily available

SYNCOPE

Definition Syncope is an abrupt fall in blood pressure due to inhibition or temporary anæmia of the vital centres in the medulla especially the vasomotor centre It differs from shock *in that if the*

Human Blood Blood transfusion, in which actual blood is restored to the circulation, is more effective and is much to be preferred in the severer cases of shock for transfused blood not only replaces blood volume but it also supplies the active functioning tissue which has been lost The two chief difficulties that had to be overcome to make this a practical procedure were —

1 Clotting. This is liable to occur during transfusion and prevents its completion It has been overcome by adding to the blood certain salts *e g* oxalates or citrates, which combine with the calcium of the blood and prevent coagulation

2. Incompatibility between the bloods of different individuals, as manifested in the agglutination and hæmolysis of a patient s corpuscles by the serum of another If this occurs to any marked degree, a fatal result ensues

The compatibility of the donor s blood with the recipient s depends on their blood groups These are determined by mixing a drop of blood with blood sera belonging to known groups If agglutination occurs the blood runs into small masses resembling grains of pepper (See Chapter 7)

In a situation where stock sera are not obtainable a direct test between the proposed donor s corpuscles and the recipient s serum should be carried out In default of a specimen of the patient s serum and where time is of great importance as with a profuse hæmorrhage a drop of blood from both donor and patient may be placed on an inverted china plate or saucer with a drop of 3 8 per cent. sodium citrate solution (to prevent clotting) and the occurrence or absence of agglutination noticed.

Obviously no one suffering from any disease communicable by the blood, such as syphilis tuberculosis or malaria, should be employed as a donor

Post transfusion reactions occur in some cases usually within an hour or two and are characterized by chill and fever, nausea and vomiting, and occasionally urticaria and severe headache They are usually due to the use of poorly cleaned although sterile tubing in the transfusion apparatus

Plasma and Dried Plasma For the emergency treatment of shock plasma transfusions are superior to infusions of saline dextrose and acacia solutions since plasma possesses a high protein content and therefore it exerts a high colloidal osmotic pressure

The plasma is readily obtainable by centrifugation of citrated blood either immediately or on expiration of the customary period of preservation in a blood bank a pint of citrated blood yields from 250 to 300 ml of plasma.

The practical advantages of plasma over whole blood for intravenous administration are its readiness for immediate use without the

syncope it must be borne in mind that it is useless to administer drugs hypodermically or intramuscularly, the circulation of the blood in the tissues may be so poor that there is great delay in their reaching the general circulation These drugs must therefore be administered intravenously in such cases

COLLAPSE

Collapse indicating a fall in blood pressure, is a term which is used in somewhat different senses by different surgeons The fall in blood pressure may depend on —

Syncope, i e inhibition or temporary anæmia of the vasomotor centre

Sudden loss of fluid from the circulation, whereby the blood volume falls, the circulation is lessened and the supply of oxygen to different parts of the body is diminished, as in hæmorrhage severe diarrhœa or prolonged vomiting

Toxic injury, where the poison or toxin diminishes the vasomotor control as, for example, in peritonitis

CONCUSSION

Definition Concussion is a condition where the brain because of injury ceases temporarily to function

Cause Instead of originating from impulses transmitted by afferent nerves to the vital centres in the medulla as in syncope, the symptoms of concussion arise through direct mechanical violence to the cells of the brain itself

There is an instantaneous generalized disturbance of consciousness due to injury to the cortex Injury to the medulla is evidenced either by stimulation or inhibition of the medullary centres (vasomotor vagus and respiratory) which causes changes in blood pressure pulse rate, and respiration Concussion is a temporary condition and tends to spontaneous recovery without sequelæ

In death from pure concussion we find those conditions which are found in shock, but no cerebral lesion can be demonstrated Where unconsciousness persists for more than an hour some more serious complication is present

Clinical Signs The state of a patient suffering from concussion may be described as follows He is unconscious in the first or second degree (see below) the pulse rate is accelerated and of reduced volume the respirations are quick and shallow the blood pressure is reduced, the temperature is subnormal the muscles are flaccid the appreciation of pain is diminished and the skin is pale with lowered surface temperature

In some cases the unconsciousness becomes deeper and the patient remains unconscious for hours or days The pulse rate falls,

patient does not succumb in the first few minutes after its onset it is easily and readily treated

Causes CEREBRAL ANÆMIA Just as holding a hutch rabbit up by the ears may cause it to faint, so a patient may faint on assuming the erect position after a severe illness Here the blood gravitates to the abdominal vessels owing to their lack of tone

REFLEX INHIBITION OF THE VASOMOTOR CENTRE This occurs through a violent afferent nerve stimulus arriving at the centres either from the psychical side, *i e* the emotions, or from a sudden violent sensory stimulus such as a blow on the abdomen

RELATION TO ANÆSTHESIA Syncope during anæsthesia may be due to two conditions

(a) Reflex inhibition of the centres in the medulla, owing to incomplete anæsthesia allowing the centres to be inhibited by the stimulus of the operation

(b) Cerebral anæmia, due to any sudden movement of the anæsthetized patient such as rolling him over which allows the blood to gravitate into the dependent vessels in which the tone is decreased

Clinical Signs These are practically identical with those of shock but are more sudden in their onset

Treatment This differs from that of shock in that we only require the treatment to act for a matter of minutes until the inhibition or anæmia passes off

MECHANICAL STIMULANTS may be tried such as the head down position and the application of pressure to the abdomen

STIMULANTS ACTING ON THE VASOMOTOR CENTRE DIRECTLY OR VIA THE CENTRAL NERVOUS SYSTEM These sometimes whip up the anæmic or inhibited centres into a state of activity until the condition of syncope passes off They may be given by mouth intravenously or hypodermically

Stimulants by the Mouth Various forms of alcohol, Sal Volatile etc , may be administered by the mouth

Hypodermically The following may be given —strychnine (gr $\frac{1}{32}$ to gr $\frac{1}{8}$) caffeine (gr i to gr v) camphor (gr ii to gr iii)

STIMULANTS ACTING ON THE HEART are often useful in stimulating the heart directly in cases of syncope for example, digoxin (0 5 mg)

STIMULANTS ACTING DIRECTLY ON THE MUSCLE COAT OF ARTERIES such as adrenalin (1/1 000 ♏ii to ♏vii) pituitary extract, ♏iv Neo Synephrine ($\frac{1}{2}$ to $\frac{3}{4}$ ml) Methedrine (20 to 30 mg), ephedrine (gr i) and ergotoxine (1 mg)

These drugs act on the arteries directly and cause their contraction, and thus the blood pressure is raised and the inhibited centres are allowed to recover With adrenalin the action is only a matter of minutes for it is rapidly oxidized and excreted In cases of severe

Any attempt at physical restraint may be resented and, whenever possible, should be avoided because in the effort intracranial pressure may rise at a time when this is least desirable

Morphia not only depresses the respiratory centre, but it may disguise a deepening unconsciousness which otherwise would indicate the onset of compression Thus it should also be avoided

CEREBRAL IRRITATION

Definition Cerebral irritation is a clinical rather than a pathological conception and is associated with bruising of the brain

Clinical Signs In the slighter forms there is a condition of mental irritability associated with severe headache vomiting and giddiness, also for some days there may be a slightly raised temperature and a slow full pulse

In the severer forms the patient when roused out of his drowsy stupor is in a state of extreme irritability towards everyone and everything yet physically he is markedly depressed and lies curled up in bed with all his limbs flexed The pulse is slow and full and the temperature slightly raised Usually after a day or so the patient comes out of his stupor and only has a vague notion of what has happened There is lack of memory for the events at the time of and before the accident (retrograde amnesia) in fact no concussed person ever knows the exact details of his accident

It is not the damage to the skull *per se* that is important but rather the damage to the underlying brain A fractured skull may be associated with little or no damage to the underlying brain or on the other hand a fatal head injury may occur with an intact skull Fracture of the base of the skull is of more significance since the force needed to fracture the buttresses of bone in the base of the skull will always be associated with fairly severe damage to the brain However once the diagnosis of a fractured skull of any type has been made the patient should be treated as though he has a severe injury to the brain

Treatment Here we must avoid stimulants for they may increase the intracranial pressure

In major contusion the patient requires prolonged mental and physical rest he should be left alone except for the necessary attention to the bowels urine feeding etc The room should be darkened and absolute quietness maintained

He should be nursed on his side with the head raised to promote venous return from the brain and an adequate water balance maintained preferably by the use of an indwelling nasal catheter

The food should be liquid in character and if the patient refuses to take it nasal feeding may be necessary

Closed head injuries that is those in which there is not a compound fracture are usually associated with a rise in the intracranial

its volume increases, the respiratory rate falls, but there is a coincident increase in the amplitude The blood pressure is considerably increased the temperature rises, there is restlessness, particularly when any stimulation is applied to the body surface, the face becomes flushed, the pupils are equal and contracted and the urine is retained

In other words, the stupor of concussion passes almost imperceptibly into the unconsciousness of *compression*

If the compressing force is focal in its immediate effects, certain local peripheral phenomena, such as *flaccid paralysis* or *a dilated and fixed pupil*, may also become manifest

Following a severe injury the patient passes into a condition of mild or severe cerebral irritation Here the patient is suffering from something more than concussion, namely contusion of the brain with *associated cerebral œdema and petechial hæmorrhages*

If an interval of full consciousness supervenes between concussion and the onset of compression certain signs and symptoms may be noted A severe insistent headache occurs there is an intolerance to bright light (photophobia) and the patient becomes restless and excitable unduly irritable and even irrational

In the cases in which there is a latent period between the concussion and the development of cerebral compression the gross damage to the brain is not the direct result of the original injury, rather it is due to compression by the increasing hæmatoma resulting from a torn middle meningeal vein It is just such a case that requires immediate surgery for the pressure *must* be relieved before the brain is irretrievably damaged

Treatment Concussion is tantamount to shock and should be treated accordingly

The patient should be wrapped up in blankets, placed flat on his back and kept as quiet as possible in a darkened room The head should be turned on one side and the jaw held forwards

Any fluid or vomitus in the mouth pharynx or larynx should be removed with a sucker

Fluids should be administered by mouth, or if this is impossible, by an intranasal tube

Owing to its tendency to induce a sudden rise in blood pressure, which might thereby initiate intracranial bleeding and to increase the intracranial pressure the intravenous introduction of fluids is avoided unless there has been a severe loss of blood

Restlessness presents a major problem and provided it is not due to a distended bladder is best controlled by the administration of chloral hydrate combined with potassium bromide (gr xv to gr xx of each) by mouth, by paraldehyde (ʒi per stone of body weight up to ʒviii per rectum or by Sodium Luminal (gr iii) by intramuscular injection

2 An imperative question, spoken loudly close to the ear

3 The induction of a painful stimulus by pressing the fingernail against the supraorbital notch

4 Testing the corneal reflex

Response to the first indicates a confused consciousness

Stupor or drowsiness is defined as a condition in which the patient is dazed or sleepy, but can be roused, more or less completely, and induced to answer questions

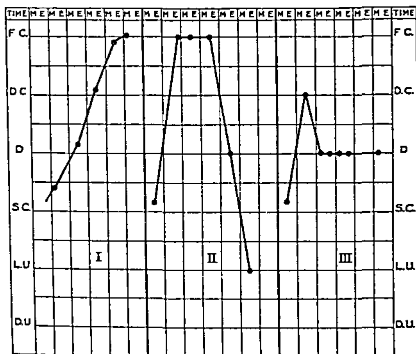


FIG 212 Consciousness chart showing —

I Recovery II Intracranial hæmorrhage III Cerebral irritation (cerebral œdema) (F C —Full consciousness D C —Dulled consciousness D —Drowsiness S C —Semi consciousness L U —Light unconsciousness D U —Deep unconsciousness)

Semi coma or semi consciousness is a further degree of stupor where whilst the patient is sufficiently conscious to be roused he is unable to answer questions In this state although the patient is not co operative and is unresponsive his general condition is good he is not cyanosed his pupils are normal and he is able to move in bed

Coma or deep unconsciousness exists in those patients who are deeply comatose with widely dilated pupils and sluggish corneal reflexes cyanosis irregular stertorous or Cheyne Stokes respiration, and flaccid limbs

These changes should be carefully noted and charted

pressure because most of these injuries are accompanied by hæmorrhage and œdema, and the skull and spinal canal are a closed system which does not permit any appreciable increase in its volume

Numerous methods have been recommended for reducing the intracranial pressure in such a case but many of them are of doubtful value For example an intravenous injection of 2 to 3 ounces of a 15 per cent solution of sodium chloride may be given in an attempt to control the increase in the intracranial tension but this is likely to be followed after 2 hours or so by a secondary rise in the intracranial pressure Hypertonic solutions of dextrose (25 to 50 per cent solutions in doses of 4 to 8 ounces) are also used for this purpose They produce a slower but more prolonged fall of pressure than the hypertonic saline and are followed by less secondary rise in pressure

An alternative method of cerebral dehydration is the oral administration of magnesium sulphate three ounces of a 50 per cent solution is the dose given The magnesium sulphate solution can also be given rectally (six ounces of a 50 per cent solution or if this is too irritating, eight ounces of a 25 per cent solution) These methods, however have definite disadvantages in very irritable and restless patients and unless the enema is retained for at least half an hour it will not produce its maximum effect It may be repeated in an hour

Instead of the hypertonic solutions of glucose or saline, five times concentrated serum may be administered intravenously

Since the above methods operate by dehydration, the patient s intake of fluids should be restricted if their full effect is to be obtained

Aspiration of the cerebrospinal fluid from one of the ventricles of the brain (ventricular puncture) is more efficient in giving relief from increased intracranial pressure than any intravenous injections of hypertonic solutions and is to be preferred after operation Once the burr holes have been made in the skull aspiration may be repeated as required and with little inconvenience

The removal of cerebrospinal fluid by lumbar puncture is not used for relieving increased intracranial pressure for in these cases it may be followed by a downward movement of the brain into the foramen magnum of the skull with pressure on the vital centres of the medulla Such an occurrence may be rapidly fatal

Prior to any operation for the treatment of a head injury it is essential that the head is completely shaved This is necessary since more than one opening may be required in the skull and it is surprising how often complete shaving will uncover local lacerations that have not been previously discovered

In attempting to estimate the depth of unconsciousness four tests should be applied in the following order

1. A simple question such as What is your name?", spoken in an ordinary tone of voice

CHAPTER 18

BURNS AND SCALDS

Definition A burn is caused by the contact of dry heat, such as flame or hot metal, with the tissues, whereas a scald is an injury to the tissues produced by the application of moist heat or hot fluids such as water, oil, tar, etc

Classification Formerly, Dupuytren s classification which divided burns and scalds into six degrees according to their depth was adopted Such a classification was unduly complicated and yet incomplete the important things to know about the burn are firstly its extent and secondly whether or not there is complete destruction of the skin

Nowadays it is more usual to divide burns into three groups —

1 Those showing simply a redness or erythema of the skin
2 Those showing blistering and an incomplete skin loss and
3 Those showing complete destruction of the skin

It is the extent of the burn rather than its depth that is the essential factor in determining the fatalities and therefore any description of a burn should include an estimate of the extent of the body s surface that is burnt compared with the area that is not affected Other factors that affect the mortality rate in burns are the age of the patient (the very young and the very old have a higher mortality rate), the type of treatment adopted, and the efficiency with which the nursing care is carried out

The extent of a burn may be estimated from the following figures which state the percentage of the total body surface constituted by the following parts Head—6 per cent , Trunk—40 per cent , Upper Limb—8 per cent (including hand—2 per cent) and the Lower Limb—19 per cent (including foot—3 per cent)

Stages in the Course of a Burn In an extensive burn these may be those of shock, toxæmia and sepsis followed by the stage of repair The stage of sepsis may be avoided by preventing infection (with streptococci etc) by means of an efficient dressing technique The stage of toxæmia is only seen in cases with extensive burns or in whom infection has been allowed to develop

STAGE OF SHOCK This consists of the stage of primary shock which occurs immediately after the injury and the stage of secondary shock or burns shock which comes on a few hours after the injury and which may persist for days

Primary shock is due to the stimulation of the nerves by the injury whereas secondary shock is due mainly to the loss of fluid from the

The pulse and respiratory rates, together with the temperature and blood pressure readings, should also be recorded at half hourly intervals for the first twenty four hours and thereafter at hourly intervals

In the period which immediately follows a head injury of any severity, the blood pressure falls and as recovery takes place the pressure gradually readjusts itself to the average figure If after the preliminary fall the blood pressure continues to rise to a high level, an increase of intracranial pressure should be suspected

A slowing pulse rate in association with an increase in volume, is a hint that cerebral compression is developing that is that an attempt is being made by the heart and circulation to maintain the blood supply to the brain despite the increased intracranial pressure

A much quickened respiration points to serious cerebral contusion, usually of a diffuse character

If a temperature of 103° Fahr is exceeded the body temperature should be controlled by tepid sponging etc

Pure uncomplicated concussion does not exhibit pyrexia, hence a steadily rising rectal temperature indicates that some degree of cerebral trauma has been sustained

In short, during the critical stages the nurse must keep a detailed record of the following phenomena —restlessness involuntary micturition and defæcation, pulse rate and quality respiration rate, blood pressure and hourly rectal temperature

After a head injury the ears should not be syringed out If they contain dirt or blood this should be removed with forceps or with swabs on swab sticks, otherwise infection may be driven further into the ear and even into the meninges and brain If there has been bleeding from the external auditory meatus it should be covered with a sterile dressing after the blood has been carefully removed

If the fracture of the skull involves the roof of the nose (cribriform plate of the ethmoid) the flow of a clear and colourless fluid from the nose should be watched for and reported Such fluid may be cerebro spinal fluid which is leaking through the fracture site If a leak of cerebrospinal fluid from the nose (cerebrospinal rhinorrhœa) is suspected the patient should not blow his nose lest infection is forced up into the meninges and brain

In cases of major contusion of the brain the chance that the patient will be able to return to full work is less than one in three and there is the same chance of total incapacity However the chance of recovery of any individual patient will be greatly increased by careful nursing

treatment of burns is the prevention of infection of the burnt surface The burn should be covered with a sterile dressing or, if this is not readily available, with a freshly laundered towel sheet, etc The inside of the folded linen is applied to the burn, and nothing else is allowed to touch the burnt surface It is important to remember that blankets are rarely washed and may be very contaminated Anyone examining the burn must wear an efficient mask If the burnt surface is still covered with clothes these should not be removed till the burn is cleansed and dressed in hospital

For application to a burn under conditions in which hospital treatment is not available Cetavlon cream or gentian violet jelly is very suitable, and should be applied without cleaning or removing the blisters Tannic acid jelly may be used instead in such circumstances but only if it is not applied to the face hands feet, perineum or buttocks as it forms a coagulum on the surface of the burn and in these situations it may crack with movement Infection is very likely to occur through these cracks and, as a result, healing is delayed and more scar tissue forms

All burns should receive an injection of tetanus toxoid or antitoxin (see Chapter 5)

Local Treatment Any local treatment apart from covering the burn with a sterile dressing is delayed until the general condition of the patient is satisfactory

Cleansing

Cleansing of the burn is carried out in the operating theatre or in a special burns dressing room with the same aseptic precautions as are used during other operations Such cleansing is preceded by adequate injection of morphia or similar drug and it should not be so rough as to require a general anæsthetic

The skin is cleansed with Cetavlon or similar substance any blisters are opened, and all loose skin removed The area is then gently swabbed with saline dusted with penicillin and sulphanilamide powder and covered with tulle gras saline packs and dry dressings held firmly in place with crepe bandages

Local Applications

The saline pads are kept moist and the dressings are soaked off in a saline bath every couple of days The wounds are then swabbed with saline and firmly re dressed as before If the burn is superficial and infection does not occur these dressings may soon be changed to tulle gras covered with dry dressings If there has been complete loss of the skin grafting will be carried out as soon as possible that is, as soon as the patient s general condition is satisfactory, as soon as any sloughs separate and as soon as pathogenic organisms are eliminated from the wound

blood on to the burnt surfaces and into the burnt tissues This loss of fluid results in an increase in concentration of the blood, that is, in a hæmo concentration The normal hæmatocrit reading, which is an estimate of the ratio between the amount of cells and the amount of plasma in the blood, is 45 per cent If fluid is lost from the blood, this ratio rises In cases of extensive burns it may rise to 65 per cent or more

STAGE OF TOXÆMIA This stage is probably due to the absorption of toxic materials which have formed due to the destruction of the burnt tissues and it comes on after the first day or so It may last for several days and is associated with an elevated pulse rate and temperature nausea, mental confusion, lassitude an increased respiratory rate, and later maybe, with delirium, coma and death In some cases jaundice occurs

STAGE OF SEPSIS Apart from the mild burn causing an erythema only a burn is much more liable to become infected than an ordinary wound

In burns it is especially important to prevent infection for, if such infection becomes established it may destroy any islands of epithelium which had escaped destruction at the time of the original injury As a result of this, healing of the wound is delayed and, consequently, an increased amount of scar tissue is formed

With the onset of sepsis in the burn the patient may show a septic fever, and there may be a spread of the infection to other parts of the body The formation of pus is likely to occur beneath any sloughs and the removal of these should be accelerated

STAGE OF REPAIR Here the same changes occur as in the healing of an ulcer or wound by granulation A fine film of epithelium spreads in from the edges and also from any foci of skin which have not been destroyed This regeneration of the epithelium occurs at the rate of about an eighth of an inch per week

In the first two degrees more or less complete regeneration takes place but in the deeper burns all the elements of the skin have been destroyed and unless the wound is skin grafted excess scar tissue is produced which undergoes subsequent contraction The complications of this stage of repair are mostly the results of long continued septic intoxication but this can be eliminated if the treatment is conducted along the lines used for other granulating wounds

Treatment The essentials of the treatment of burns are —

1 To prevent infection
2 To lessen shock and toxæmia
3 To maintain the general condition of the patient
4 To replace skin loss by grafting as early as possible
5 To restore the function of the affected part

FIRST AID TREATMENT The most important point in the first aid

Bunyan s method has the advantage that it is possible to watch the process of healing through the transparent envelope and it is especially of value in cases in which extensive burns coexist with other wounds of the limb

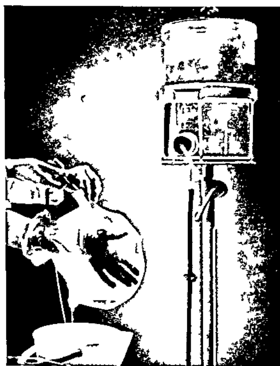


FIG 213 The method of use of a Bunyan bag in the treatment of a burn of the hand
(*Photo courtesy Milton Antiseptics Ltd*)

Dressings

The dressing of burns provides one of the best examples of the value of asepsis The development of infection in a burn is usually due to contamination at the time of the initial or subsequent dressings and may be avoided

Ideally, the dressings should be carried out in an air conditioned dressing room employing a no touch technique No blankets are taken into the dressing room and clean sheets are provided at the time of each dressing The soiled dressings are placed in a bucket and this is later wheeled outside the dressing room and emptied The doors of the dressing room are not opened during the dressing Everyone present will of course wear a clean cap mask and gown but the number of people present during the dressing will be kept to a minimum All dressings should be *much larger* than the burn, and the gauze dressings should extend well beyond the tulle gras The dressings should be firmly applied so that some compression of the burnt area is obtained

The 'gallows' position, as for fractured femur, is a useful one for burns about the perineum and buttocks in children

Formerly, it was the practice to spray the cleaned burn with 2 5 per cent solution of tannic acid with the idea of producing a tan on the burnt area Under that treatment the pain subsides, toxins are locked up in the coagulum, and the patient becomes very comfortable Unfortunately however, infection may occur deep to the tan especially in the creases of the body, on the face, hands, feet, perineum and buttocks, and this method is rarely used now Under no circumstances must tannic acid ever be allowed near the eyes as it will cause permanent damage Infection is also likely to occur beneath tanning produced by other methods such as the application of triple dye (1 per cent aqueous solution of gentian violet and brilliant green and 0 1 per cent solution of neutral acriflavine)

Whatever local method of treatment has been used, the affected part should, if possible, be elevated to reduce the exudation of fluid

Local Excision

If it is certain that the burn extends deeper than the skin and is localized it is occasionally possible to excise the burnt area and to apply a skin graft but when first seen, it is often difficult or even impossible to determine whether there has been complete destruction of the skin or not

The Exposure Treatment

Instead of applying saline pads and other moist applications the burnt surfaces may be left exposed and kept dry and sterile

After cleansing and removing the loose skin the surface is dried and the patient is nursed on sterile sheets Penicillin injections are given the affected part of the body is elevated and immobilized and apart from swabbing daily with Cetavlon no local application is employed

General measures are of course just as important as with other methods of treatment

The patient is nursed in a warm ward and cold draughts are avoided However the warm air from an electric hair dryer may be very useful in helping to dry the surface of the burn

Irrigation Envelopes

Bunyan has evolved a method of treatment (Fig 213) by irrigation of the burn with weak solutions (2 5 per cent) of electrolytic hypochlorites which is of value in the treatment of deep burns of the limbs Special envelopes of fine silk coated with synthetic resin and having inlet and outlet vents are sealed around the burnt limb by adhesive silk, strapping or pneumatic bands and intermittent irrigation is carried out till epithelialization is complete The irrigation is carried out for twenty minutes three times per day until the infection is overcome, and thereafter twice daily

It is also required if the area burnt is more than 10 per cent of the whole body in a child or more than 15 per cent in an adult The *amount of serum* required in an adult may be roughly estimated as being 1 litre for every 10 degrees rise in the hæmatocrit reading or for every 20 per cent rise in the hæmoglobin level In the adult the first litre should be given quickly and thereafter the rate of flow into the vein should be about 40 drops a minute till the desired amount is given Although some estimate may be made from the initial examination of the amount of the serum required, the injection of the serum is continued until the subsequent examinations of the blood show that *the hæmo concentration is overcome* In the child the amount of serum and its rate of administration are correspondingly less

Attempts to replace serum loss by Normal saline solution may lead to such a fall in plasma protein that œdema results

Toxæmia The toxæmia of burns may be fatal and it is partly due to infection Thus, every effort must be made to prevent infection

During the stage of toxæmia anæmia may develop and this is best treated by blood transfusion

Sepsis The most important thing about the treatment of sepsis is its prevention In many cases in which sepsis occurs it could have been prevented by the avoidance of contamination in the early stages

As a result of the infection and the absorption of toxins and the loss of proteins the patient becomes debilitated and attention to the diet and to stimulating the appetite are most important During this stage an increased intake of protein is necessary and this may be provided by concentrated drinks of skim milk meat, eggs bacon etc

Saline baths are useful *in removing the exudate from infected or* deep burns and are often very comforting to the patient especially if there are extensive burns of the body

When the patient is admitted to hospital penicillin injections are commenced as a prophylactic measure If however infection does become established, penicillin sulphonamides streptomycin etc may be required

Stage of repair and of restoration of function During this stage the occupational therapist is often of assistance for if the burns were deep the patient may be in hospital for many weeks and it is necessary to maintain his interest in things about him and especially to maintain his appetite Equally *important in this regard is the part of the* nursing staff

Physiotherapy is often essential to restore the wasted muscles and to *improve the movements of the joints*

Burns of the Eyes and Eyelids

Thermal and chemical burns of the eyes and eyelids are discussed in Chapter 34

Infected Burns

If the patient is admitted with gross infection of the burn, Milton or eusol compresses are applied at first, then, when the suppuration subsides the type of dressing employed will depend on the organisms present Usually, the infection will be a mixed one with streptococci and staphylococci predominating and thus the use of penicillin and sulphanilamide powder covered with tulle gras is indicated If Bacillus proteus is present, 2 per cent acetic acid may be tried If there is gross contamination with Bacillus coli and other organisms an antibiotic will be used depending on the results of sensitivity tests on the organisms Quite often it is found that the infecting organisms are sensitive to streptomycin

If sloughs are present pyruvic or phosphoric acid dressings will aid in their separation These acids may be applied in a starch paste

Special local treatment is necessary for burns due to chemicals, for example an application of a 2 5 per cent aqueous solution of copper sulphate should precede other treatment of a phosphorus burn

After the burnt surface or the grafted surface is healed the scars may become more supple if lanoline is rubbed in daily for many weeks

GENERAL TREATMENT The general treatment of burns may be discussed in the various stages

Shock Primary shock immediately follows the upset to the nervous system from the burn and tends to pass off within six hours It is characterized by collapse subnormal temperature and failing pulse and respiration Treatment consists essentially of morphia, rest and warmth

A moderately large dose of morphia or similar drug should be given at the earliest possible moment to minimize primary shock Fluids are given by mouth and the patient is kept warm but not over heated and at rest in bed Oxygen administration may be helpful

After the primary shock has passed off a further dose of morphia is given and the treatment of the burnt area undertaken

The secondary shock of burns is mainly due to hæmo concentration resulting from the loss of fluid into the burnt tissues and from the surface of the skin It therefore follows that hæmatocrit readings or what is essentially equivalent hæmoglobin estimations or red blood cell counts form an important guide to the condition of the patient During the first day hæmo concentration should usually be measured at four hourly intervals and for the subsequent week an estimation is made once a day

As a working rule it may be assumed that if the systolic blood pressure falls to 90 mm a serum (or plasma) transfusion is required

Instruments required for Tracheostomy

Apparatus for general or local anæsthesia

Hard pillow or sandbag to raise the patient s shoulders so that the neck is stretched

Sucker tubing and two sucker heads

2 Scalpels (No 3 handle with No 10 blade)

2 Dissecting forceps (plain and toothed)

3 Tracheostomy tubes (different sizes) and tapes

Tracheostomy dilator and pilot

2 Sharp and 2 blunt hook retractors

12 Artery forceps

2 Aneurysm needles

2 Scissors (one stout)

2 Needle holders

Ligature and suture materials

4 Needles (curved and straight)

Brushes to clean the tube

The operation may be performed under general or local anæsthesia The patient should be held with the chin so raised that the front of the neck becomes a plane surface and the head must be kept rigidly

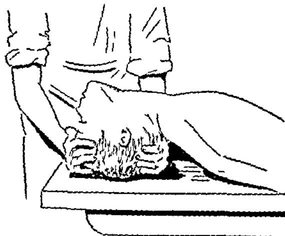


FIG 215 Position for tracheostomy

in the median plane so that the trachea is not displaced laterally If the patient is a child the arms should be secured to the sides by a binder

The tracheostomy tube is inserted into the trachea on its pilot and firmly tied in place by tapes round the neck of the patient

A good dressing is a layer of boric lint which is inserted under the shield of the tube and changed as often as is necessary

After treatment of Tracheostomy Cases. The nurse must realize at once that the success of tracheostomy depends as much on the after-treatment as on the performance of the operation

CHAPTER 19

TRACHEOSTOMY, INTUBATION AND ASPHYXIA

TRACHEOSTOMY

TRACHEOSTOMY is the operation in which an opening is made in the trachea just below the larynx In certain cases of obstruction of the larynx or pharynx it becomes necessary to perform this operation to avoid death from asphyxia The chief indications are laryngeal diphtheria, inflammation or tumours of the larynx and pressure by tumours in the vicinity of the trachea Various patterns of tracheostomy tubes are in common use viz —

The Bivalve Tube, which consists of an outer and inner tube The outer tube is furnished with two slits which permit the attachment of the tapes by which the tube is held in place, the inner tube is a little longer than the outer and may be removed for cleansing etc

Durham's Lobster-tail Tube in which the inner tube is made of separate pieces which are joined together and resemble somewhat a lobster s tail

Parker's Tube, which has an angle to prevent pressure of its lower extremity on the anterior wall of the trachea

Tracheostomy tubes are generally supplied in eight sizes As is the case with urethral catheters we have two scales in common use by which they are measured The French scale corresponding with the French catheter gauge runs from No 18 to No 32, whilst the English

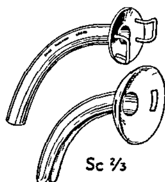


FIG 214 Fuller s tracheostomy tube This is available in sizes 16 to 32 French catheter gauge The inner and outer portions of the tube are shown separately in this drawing

scale is more or less arbitrary and runs from No 1 to No 8 For an adult a No 5 or No 6 tube (No 26 or No 28 French) for a child under two years a No 2 tube (No 20 French) for a child between two and four years a No 3 (No 22 French) and for one over four years a No 4 (No 24 French) should be used

tion of the trachea A rubber tracheostomy tube is also indicated if radiotherapy is being given near the tracheostomy opening

An inflatable rubber cuff is available for application over a Morrant Baker rubber tube (Fig 216) and is for use in cases in which assisted respiration via a tracheostomy tube is required The James rubber tracheostomy tube has a permanent inflatable cuff, but the rubber flange at its upper end is detachable

In cases of laryngeal diphtheria a further attempt should be made to leave out the tube on the sixth, eighth and tenth mornings After removal of the tube a child should be carefully watched especially at night and if natural breathing fails, the tracheostomy tube should be reinserted through the old wound

If this difficulty with natural breathing persists, a tracheostomy tube with a dorsal opening may be used, or we may intubate the patient in order to accustom him to breathing through the larynx again

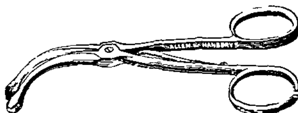


Fig 217 Bowlby s tracheal dilators

Nurses and others must be careful in attending cases of laryngeal diphtheria, sometimes called Trachy cases lest the infected discharge is coughed through the tube into their faces If any discharge should be coughed into an eye it must immediately be washed out with some weak antiseptic

The nurse should wear a mask and special overall and should wash and disinfect her hands after attending to the patient

Used swabs and soiled gauze should be placed in a bowl containing strong disinfectant

In nursing a case after tracheostomy the following articles should always be kept close at hand in readiness for use —

Sucker with tubing and catheters
Tracheal Dilators
Pilot
Bowl of Lotion to wash inner tube
Hen s Feathers
Lint or Cotton Wool
Dressing Forceps and Probe
Dissecting Forceps
Receiver
Tape

When the secretion tends to dry rapidly in and below the tube and so cause obstruction, and when there is definite broncho pneumonia the air is kept moist by one or more bronchitis kettles

A layer of almost dry gauze is placed over the exit of the tracheostomy tube to keep out dust This gauze apron *must* be changed as soon as it becomes wet with mucus etc

The three objects a nurse must always attain in nursing a tracheostomy case are —

(i) To keep the tube free from mucus or blood
(ii) To maintain the room temperature at or above 65°–70° Fahr
(iii) To support the patient's strength

The lumen of the tube must be kept free at all times

The nurse must always be at hand to swab or suck out the tube and especially to catch any mucus or piece of membrane which is coughed up so that it will not be sucked down into the tube again An intelligent adult patient may soon be taught to use the sucker to clear the tracheostomy opening himself

If the exudation is moist it is easily brought up by coughing or by inserting a feather down the tube and twisting it around before removing it On the other hand if the secretions are dry and tenacious the nurse should as an ordinary procedure remove the *inner* tube as often as is necessary to clear and clean it *i e* about every hour or two at first Hot water to which some carbonate of soda is added cleanses it most effectually and the tube is then boiled dried and quickly reinserted

When removing the *inner* tube the *outer* tube should be held in position with the thumb and forefinger of the left hand or it may be accidentally pulled out

The pain in swallowing and the disablement caused by the tube at first are to be remembered the patient has to learn to swallow with the tracheostomy tube in position and this may cause much trouble For the first few days the invalid is fed on liquids by means of a feeder with a piece of rubber tube attached to its spout Food must be given at frequent intervals and the diet is steadily increased as the pain and hindrance becomes less If there is much difficulty in getting the patient to swallow nasal feeding must be employed On the fourth day if the tube cannot be dispensed with a rubber one should be substituted so as to avert ulcera

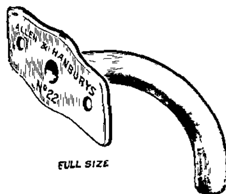


Fig 216 Morrant Baker s rubber tracheostomy tube

A set of Metal Intubation Tubes
An Introducer and Extractor
A mouth Gag and Silk Thread

An intubation tube consists of a fusiform tube which at one end has an expanded head prolonged backwards to prevent its slipping through the vocal cords The anterior part of the head is perforated for the attachment of a piece of thread Each intubation tube is provided with an obturator which can be screwed on to the introducer The instruments should be sterilized before use

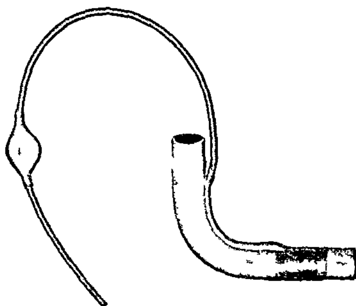


FIG 218 James cuffed intratracheal rubber tube for use through a tracheostomy opening

Technique of Operation The patient with the arms by the side, should be pinned up in a blanket or sheet from chin to feet and sat on a nurse s lap The nurse places her arms round the child s body holds the feet tightly between her knees and supports the head with her right shoulder A second nurse standing behind holds the patient s head firmly against the first nurse s right shoulder keeping the child s neck stretched and straight and at the same time she steadies a gag in the right corner of the mouth

Some surgeons, however prefer to intubate with the patient lying flat with a small sandbag placed under the neck

A tube of a size corresponding to the age of the patient is selected and threaded with a piece of thread two or three feet long The surgeon then introduces the tube on the introducer releases it, and pushes it home into the larynx with his index finger

The *outer* tube should not be removed for at least three days, *i e* until a distinct tract has been formed for reintroduction withdrawal at an earlier period may be attended with insurmountable difficulties as regards reintroduction of this tube Hence, with children it is necessary to be extremely watchful lest the tracheostomy tube is pulled out in a paroxysm of difficult breathing If this occurs in a recent case the child may die before the arrival of the doctor unless the nurse can manage to keep the wound open She should place the child across her knees, with the head thrown back and if she is unable to reinsert the tube she must keep the opening in the trachea open with the dilators until the doctor arrives

Finally in nursing tracheostomy cases the nurse must always provide the patient with a pencil and paper and, when it is possible to leave him alone a bell should be placed near at hand

Complications of Tracheostomy IRRITATION AND ULCERATION OF THE TRACHEA by pressure from the tube is fairly common When ulceration occurs the mucus expelled from the tube is streaked with blood and this should always be regarded as evidence of an ill fitting tube

SURGICAL EMPHYSEMA of the soft tissues of the neck may occur when the tube is dislodged from the trachea as in coughing The condition is not serious but may necessitate the introduction of a longer tube to reach beyond the tissues swollen with air

ASPIRATION BRONCHO PNEUMONIA may occur It is best averted by keeping the patient in a warm atmosphere avoiding draughts, filtering the inspired air through gauze and sucking excess fluid from the trachea

SEPSIS may be due to infection with the diphtheria bacillus or pyogenic organisms and may lead to sloughing of the wound

INTUBATION

Intubation of the larynx (the introduction of a tube into the larynx) is used in some cases of laryngeal obstruction The operation was originally devised for obstructed respiration in cases of laryngeal diphtheria but it is also employed as an alternative to tracheostomy in other varieties of laryngeal obstruction

Intubation has the following advantages over tracheostomy it is a trivial operation requires no preparation can be performed as easily in a bad light as in a good one and the after nursing is not nearly so heavy as after a tracheostomy

On the other hand considerable practice is necessary for the surgeon to become expert in its use Also if the patient coughs up the intubation tube and becomes asphyxiated the nurse cannot do anything to save the patient s life as she can after a tracheostomy

The instruments required are —

SWELLING OF THE WALLS OF THE AIR PASSAGES, which may arise from acute inflammation, *e g* œdema of the larynx following the inhalation of steam or the vapour of certain corrosive poisons, from cicatricial stenosis tumours of the larynx, etc

PRESSURE ON THE WALLS OF THE AIR PASSAGES FROM WITHOUT, for example strangulation, hanging and pressure of tumours, such as *large goitres or aneurysms*

Inhalation of Poisonous or Irrespirable Gases, such as coal gas carbon dioxide (CO_2) sewer gas etc, which, by displacing the atmospheric air lead to death by suffocation

Nervous Causes Paralysis of the respiratory centre in the medulla (*e g* from an overdose of chloroform), or of the various nerves concerned with respiration will lead to asphyxia

The phenomena *of* asphyxia *when arising from sudden obstruction* may be divided into three stages —

Stage of Dyspnœa, which usually lasts about one minute and is due to the accumulation of carbon dioxide in the blood In this stage the respiratory movements are quicker longer and stronger whilst the patient gradually becomes more and more cyanotic

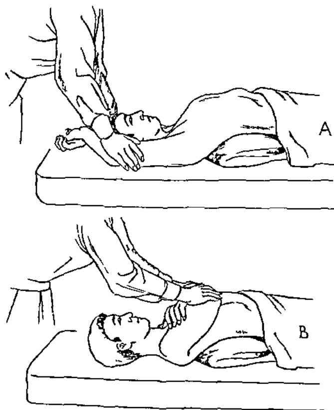


FIG 219 Sylvester s method of artificial *respiration A Inspiration* and *B* Expiration

The thread should be brought out of the corner of the mouth, hooked over the ear and secured in place by adhesive plaster

If the patient coughs out the tube after some hours, the next larger size should be inserted, if there is repeated coughing up of the tube (which is rare), tracheostomy should be performed after the third expulsion

In ordinary cases the tube should be removed on the fourth morning but if it cannot be dispensed with, a further attempt to leave it out should be made on the sixth, eighth and tenth mornings

Nursing of Intubation Cases FEEDING The intubation tube renders swallowing difficult, and the patients are only able to take liquids or, at the most, semi solid food If possible patients should be fed with a nasal tube from the time the intubation is carried out until the tube is no longer required This overcomes the danger that fluid will enter the air passages

CHECK SPLINTS The patient should be prevented from pulling on the thread by means of elbow check splints of cardboard

Complications of Intubation BLOCKING OF THE TUBE with a piece of diphtheritic membrane is very rare for as a rule such blocking is promptly followed by coughing up of the tube The nurse in charge of an intubation case should be told to pull out the tube if at any time the patient suddenly shows signs of asphyxia

If the thread has been bitten through and asphyxia occurs the nurse should encircle the patient s neck with her left hand placing the thumb on the front of the trachea just below the lower end of the tube With the right hand the patient s head is first bent far back and then brought forwards upon the chest with a quick movement at the same time the nurse presses her left thumb upwards on the lower end of the tube which is by this means driven out of the larynx, and is found in the mouth or is ejected from it

Whenever a nurse has to extubate a case or the tube comes out spontaneously a message should at once be sent to the doctor in charge, as its speedy return may be necessary

SWALLOWING OF THE TUBE If the patient swallows an intubation tube it is passed in due course *per rectum*

ASPHYXIA

Asphyxia is a term applied to those phenomena which occur when owing to interference or to stoppage of the respiratory act the respiratory centre in the medulla is deprived of arterial blood The causes of asphyxia may be classified as follows —

Obstruction of the Air Passages BY ABNORMAL CONTENTS WITHIN THE AIR PASSAGES, for example foreign bodies blood from operations on the upper air passages diphtheritic membrane etc Death from drowning arises from replacement of the air in the passages by water

the finger to ascertain if the air passages are clear When the cause has been removed artificial respiration must be applied taking particular care to see that the air passages are not obstructed and that there is abundance of fresh air The administration of oxygen instead of air is often useful in those cases where there is not total cessation of respiration *and where the air passages are clear*

Nikethamide (Coramine) intravenously, in doses of up to 5 ml of a 25 per cent aqueous solution is of some value when stimulation of the respiratory centre is indicated

ARTIFICIAL RESPIRATION is required in a variety of surgical conditions The following descriptions embrace the more common methods —

Sylvester's Method and *Schafer s Method* These are illustrated in

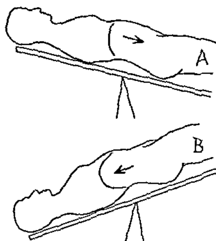


FIG 221 Diagrams to show the mechanism of Eve s rocking method of artificial respiration *A* Inspiration and *B* Expiration

Figs 219 and 220 The double movement in each method occupies about five seconds, two of which are taken up by pressure during expiration and three by relaxation during inspiration

Eve s Rocking Method (Fig 221) necessitates some kind of lever and a fulcrum The patient is firmly strapped to a stretcher or board and stops are placed above and below the shoulders to prevent sliding When the head is tilted down the abdominal viscera press on to the diaphragm and compress the contents of the chest producing expiration, with the feet down the viscera pull the diaphragm back into the abdomen the thoracic cavity is enlarged, and inspiration results

An angle of rock of 45° is adequate and should be employed at a rate of eight to nine rocks per minute, the seven second cycle being divided into four seconds head down and three seconds feet down in order to obtain the full circulatory benefits of the head down position

Stage of Expiratory Convulsions, which is due to the lack of oxygen in the blood and usually lasts about one minute The respiratory movements grow violent and convulsive and almost every muscle of the body becomes involved in this convulsive expiratory effort Loss of consciousness is almost synchronous with its onset, and the pulse is slow and forcible

Stage of Exhaustion, lasting four or five minutes The convulsions suddenly cease and give way to slow, deep inspirations the patient is insensible and the pupils are widely dilated The pauses between the inspirations become longer and longer until death occurs at the end of about five minutes

Treatment The treatment of the different conditions which may give rise to asphyxia cannot be dealt with in detail, but a general plan of treatment will be indicated

In all cases of asphyxia attempts must be made to remove the cause or to remove the patient from the cause Hence, a rapid examination of the patient should be made to ascertain the cause of the trouble if the cause is not obvious, the mouth should be opened with a gag, the tongue drawn forwards and the glottis examined with



FIG 220 Schafer s method of artificial respiration *A* Inspiration and *B* Expiration

CHAPTER 20

OPERATIONS ON THE HEAD, FACE AND MOUTH

HEAD injuries especially concussion and cerebral irritation are discussed in Chapter 17

Bacteria are numerous on the surface of the scalp but suppuration is rare because of its great vascularity

For *minor operations on the scalp*, such as the removal of wens, nævi, etc, the operation area and the skin within at least one inch radius should be carefully shaved and the scalp cleansed thoroughly

The best plan is to shampoo the scalp with liquid or soft soap, so as to soften and remove all the dried sebaceous secretion This is removed with sterile water and then the hair is dried with a sterile towel and, if necessary, braided in such a way as to direct it away from the field of operation

The operation area should then be washed with ether to remove the fat and a sterile dressing applied This remains until the time of operation when the area is painted with iodine solution In order to isolate the operation area the head may be covered by a piece of jaconet which has a central hole corresponding to the shaved skin The jaconet may in turn be covered by a sterile towel also with a central hole and both towel and jaconet are firmly fixed to the scalp by clips stitches or bandages

Operations on the brain its vessels and its coverings (the meninges) are performed for the treatment of cerebral tumours aneurysms, and tearing of the meningeal vessels, especially the middle meningeal Prior to these operations the skull will be submitted to X ray examinations the C S F (cerebrospinal fluid) will be examined and various other special tests will be performed The latter include electro encephalogram (E E G a record of electrical impulses in the brain), air encephalogram (X ray examination after the injection of air into the cerebrospinal space around the brain) ventriculogram (X ray examination after the injection of air into the ventricles of the brain) and arteriogram (X ray examination immediately after the injection of a radio opaque dye into the arteries leading to the brain)

Operations on the cranium fall into two classes namely —

Craniectomy, where a large scalp flap is turned aside the skull is trephined and the opening enlarged to the required size in other words part of the cranium is removed

Craniotomy, where a large flap is turned down including both scalp and bone this is replaced at the termination of the operation

In an emergency Eve s method may be used in a child who can be lifted in the arms and rocked back and forth

When artificial respiration becomes necessary on the operating table it may be carried out (i) by intermittent pressure over the lower ribs (ii) by the old fashioned mouth to mouth insufflation, and this should be repeated every three or four seconds until normal respiration is re established (instead of direct mouth to mouth insufflation the face piece of an anæsthetic machine or a funnel improvised from a closed hand may be used), and (iii) by use of a face piece or an intratracheal tube attached to an anæsthetic machine Artificial respiration may then be provided by filling the bag on the machine with oxygen and applying regular pressure to it This is the usual manner in which the anæsthetist keeps up the supply of oxygen when a relaxant has been given and the patient s muscles of respiration are at least partially paralysed during an anæsthetic

When using any of these methods a clear airway must be obtained

of consciousness varying from confusion to coma twitching, convulsions, paralysis unequal pupils, and progressive slowing of the pulse and respiration

POSITION The patient should be nursed recumbent with the head slightly raised on a small pillow Absolute quietness is essential and anything that may tend to excite the patient is avoided

FEEDING If the patient is able to swallow, he must be fed with great care, as there is often a danger that fluid will be aspirated into the lungs On the other hand if the patient is unconscious, he will be fed by means of a nasal tube

No alcohol is allowed

Owing to loss of blood and cerebrospinal fluid thirst is often intense, and sufficient fluid should be given by mouth subcutaneously, or intravenously

TONGUE The tongue may become coated with fur, and steps should be taken to keep it moist and clean

DRESSING During the first few days the dressings may become soaked with serum or cerebrospinal fluid and frequent fresh dressings will then be required The subsequent dressings do not differ from those described for operations in general

BOWELS It is important that any straining after the operation or during convalescence is avoided

CONVALESCENCE The patient should abstain from all mental strain and business worries for several months after any operation on the brain

Special Complications RESTLESSNESS AND IRRITABILITY As with all other complications after operations on the brain restlessness and irritability should be reported to the surgeon They will be relieved by reducing any increased intracranial pressure and by sedation as described in Chapter 17

CONVULSIONS OR FITS Twitching or spasmodic movements may occur and they may affect part or the whole of the body The nurse should carefully note in which part of the body the twitchings begin, whether there is incontinence of urine or fæces during the fit whether the patient becomes unconscious and the behaviour of the patient after the fit

CHEYNE STOKES BREATHING (Fig 223) is a peculiar type of breathing

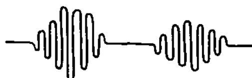


FIG 223 Diagram to show the rhythm of Cheyne Stokes respiration

characterized by a series of respirations gradually increasing in depth till a maximum is reached, then gradually dying away and finally

Preparation *When the brain is to be exposed, the entire scalp must be shaved*

Usually the head is shaved on the day before the operation, but the disadvantage of this method is that a scalp is rarely shaved without one or more small cuts being inflicted, and these cuts may become infected in a few hours

If the scalp is shaved on the day before operation, it must be thoroughly scrubbed with hot water and soap to remove as much epithelium as possible The fat and grease must be removed by ether and the scalp covered by a sterile dressing and cap

Position of the Patient during Operation The patient may be sat up in an ordinary dental chair but, although this reduces venous oozing it increases the risk of shock More often the operations are performed with the patient in a recumbent position but a compromise may then be reached by raising the head of the table so that it forms an angle of about 30° with the floor (the Hartley position) In all positions the manipulations of the surgeon will be greatly facilitated by the use of some form of head rest

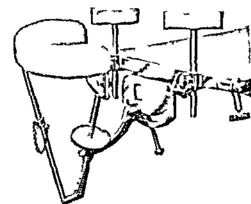


FIG 222 Cairns head support with shoulder rests for use during operations on the brain

For mopping pledgets of long fibred cotton wool wrung out of Normal saline should replace the customary surgical gauze which material tends to injure the delicate cerebral membranes and tissues A length of thread should be attached to each pledget to prevent its being lost

A sphygmomanometer cuff is fixed in place on one arm and the systolic and diastolic blood pressure and the pulse and respiration rates are noted every five or ten minutes throughout the operation and recorded on a special operation chart

The patient's fluid reserve should be reinforced by the intravenous administration of fluids or by blood transfusion

After treatment After any operation on the brain the patient should be placed under most strict observation Very careful reports must be kept and no abnormal symptom disregarded The blood pressure and pulse rate should be taken at least every half hour after operation until no marked change is probable Records must also be made of the patient's temperature which should be kept below 103° Fahr The nurse must keep a strict watch for any signs of increased intracranial tension which is characterized by impairment

of consciousness varying from confusion to coma, twitching, convulsions paralysis, unequal pupils and progressive slowing of the pulse and respiration

POSITION The patient should be nursed recumbent with the head slightly raised on a small pillow Absolute quietness is essential and anything that may tend to excite the patient is avoided

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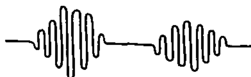


FIG 223 Diagram to show the rhythm of Cheyne Stokes respiration

characterized by a series of respirations gradually increasing in depth till a maximum is reached then gradually dying away and finally

ceasing altogether for a few seconds The cycle is then repeated Such breathing suggests a rise in intracranial pressure and is usually of grave significance

Cheyne Stokes respiration is very conspicuous, and the whole cycle usually lasts one or two minutes

During the period of respiration the pupils are dilated, the pulse rapid and movements may occur, but in the period of cessation of respira tion (apnœa) the pupils are contracted, the pulse is slow and the patient is quiet and flaccid

PERSISTENT VOMITING After operations on the brain this is usually due to increased intracranial pressure and is characterized by having no relation to food and in being unassociated with nausea

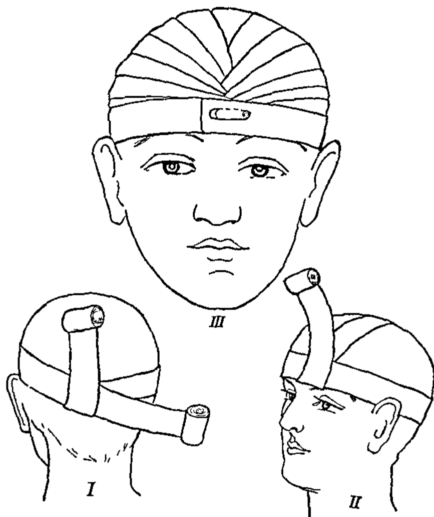


FIG 224 Capeline bandage

RETENTION OF URINE This should be treated in the usual manner If catheterization has to be performed, the most scrupulous asepsis should be maintained

BED SORES Their prevention and treatment have already been discussed (Chapter 4)

INCONTINENCE OF URINE AND FÆCES Scrupulous attention to cleanliness will help avoid bed sores

HERNIA CEREBRI, or a protrusion of part of the brain through an opening in the skull This is commonly due to unrelieved increased intracranial pressure associated with an inoperable cerebral tumour

THE ESCAPE OF CEREBROSPINAL FLUID FROM THE WOUND This may call for additional precautions to maintain asepsis, as the quantity discharged is amazingly large at times and may saturate the dressings

FUNGUS CEREBRI This is the name given to an infected protrusion of the brain It may follow a compound fracture of the skull, and the protrusion of the cerebral tissue is due to the inflammatory reaction within it The spread of infection into the brain and meninges will, if unchecked, soon be fatal

HARE LIP OPERATIONS

Hare lip is usually operated on when the infant is about two or three months of age *i e* before the teeth begin to erupt

Preparation for Operation The maximum amount of fluid (milk, etc) should be given up to four hours before operation, but nothing should be given by mouth during the four hours immediately before the operation

Until the child is anæsthetized efficient cleaning of the lip is impossible but for some days before the operation the mouth should be swabbed with glycerine of borax

After treatment FEEDING Sterile water should be given as soon as the child can take it i e from one half to two hours after operation

The quantity and frequency of the feeds vary in accordance with the age of the patient The nurse may sit the child on her lap and support him with her left arm she then takes the cup containing the feed in her left hand a small sterilized teaspoon in her right hand and pressing down the tongue and lower lip with the point of the spoon allows the milk to trickle into the mouth

In this way the child is prevented from pressing on his upper lip with his tongue while swallowing

Fluids may also be given by a catheter passed through the nose or mouth into the lower œsophagus or stomach

CHECK SPLINTS Small straight cardboard check splints should be bandaged to the arms immediately after operation to prevent interference with the wound

PREVENTION OF CRYING Crying should be prevented if possible

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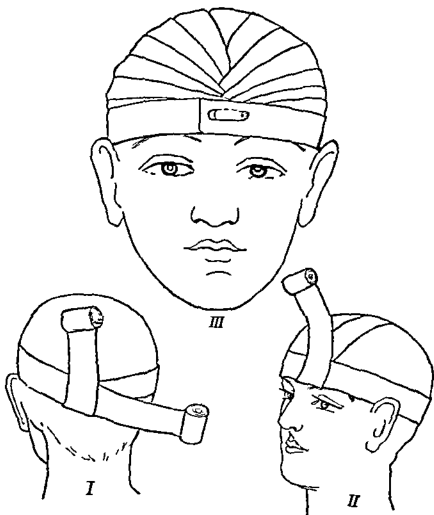


FIG 224 Capeline bandage

applied to reduce the inflammation When the inflammation has subsided, the raw surfaces should be brought together by a collodion dressing or strapping Often the results obtained by this secondary union are better than might be expected, but usually it will be necessary to excise the scar later

CLEFT PALATE OPERATIONS

The effects of a cleft palate are that —

1 Sucking is difficult or impossible, and the child must be fed with a spoon or a bottle with special teat
2 Articulation is defective, for the child is unable to shut off the oral from the nasal cavity, and
3 There is increased liability to nasal catarrh and bronchitis

Preoperative Method of Feeding Cleft Palate Babies

Since an operation on a debilitated child for cleft palate is likely to be unsuccessful every effort should be made to secure a gain in weight and an improvement in the general health of the patient before operation

Four methods are in use for feeding these babies

Spoon Feeding The child, partially propped up and reclining on its side is fed with a teaspoon into one of its cheeks By this means the food is slowly swallowed without any tendency to regurgitation The two great disadvantages of this method are that instead of the customary twenty minutes, one and a half or two hours may be expended over a meal and, furthermore the large quantity of air swallowed seriously interferes with digestion

Instead of a teaspoon a glass pipette or dropper may be used to place the food in the baby s mouth

Feeding by a Stomach Tube A small rubber catheter is gently passed over the tongue and down into the stomach with the baby in the semi sitting position

At the conclusion of the meal the catheter should be pinched between finger and thumb and quickly withdrawn

Feeding Bottle Some nurses succeed in bottle feeding cleft palate babies by using a large soft teat with a perforation so big that the milk practically runs out but the teat is so bulky that it may widen the cleft

Sucking Plate An accurately fitting sucking plate may be constructed from an impression taken of the roof of the mouth and with this plate in position the baby is enabled to suck quite normally If the baby is strong it can be breast fed but with weaklings bottle feeding will be necessary

After each feed the tape is detached and the plate after being washed in tepid (never hot) water, is submerged in methylated spirit

as it exerts strain on the wound. The nurse should always ascertain that the child is comfortable warm, clean and dry If the crying is persistent, small doses of morphia or chloral hydrate may be ordered.

DRESSING The wound may be dressed with a butterfly collodion dressing (a strip of gauze and collodion) sometimes no dressing save for a little antiseptic powder is used. Logan's traction bow (Fig. 225) is a useful instrument in the after treatment for properly adjusted, it not only prevents all drag on the suture line but allows



FIG 225 Denis Browne's modification of Logan's traction bow

free inspection for regular cleansing, etc. Triangular strips of adhesive strapping are applied to the cheeks after the operation and any subsequent slack arising from slipping of the plaster is rectified. The dressing may not need to be changed until the stitches are removed. Some of the sutures are removed on the third day and the rest within the week. To dress the wound and to remove the sutures the nurse (holding the patient's head) and the surgeon sit facing each other If available, another nurse then controls the limbs with one hand, and with the other presses the baby's cheeks together so as to take all tension off the wound. A butterfly collodion dressing or strip of adhesive plaster should be applied from cheek to cheek across the lip to prevent tension on the wound.

Complications. DYSPNŒA. The diminution in size of the oral cavity after operation may result in difficulty in breathing. Also if the lower lip becomes sucked in it obstructs respiration and suffocation may ensue. Especially during the first few hours after operation the nurse watches the airway and, using extreme care, may need to depress the lower lip

Some surgeons insert a soft rubber "breathing tube" into the mouth or nose as far as the oral pharynx this may help the baby to breathe more comfortably

The tube, which is fastened either to the cheek with adhesive strapping or around the back of the neck with tape, is removed and boiled at least once every twenty four hours.

SEPSIS. Even if antibiotics are given as a routine after the operation sepsis sometimes occurs and the line of sutures breaks down. In these cases the stitches should be removed and boric fomentations

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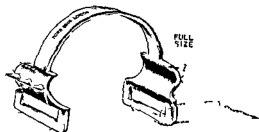


FIG 225 Denis Browne s modification of Logan s traction bow

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MOUTH AND TONGUE OPERATIONS

Preliminary Preparation HYGIENE OF THE MOUTH Before the operation the mouth should be rendered as clean as possible by removing all carious teeth and decayed stumps and by scaling the tartar from the teeth The patient should brush his teeth three times a day, and the spaces between the teeth should be cleaned by means of dental floss silk

The regular use of an antiseptic mouth wash (such as peroxide of hydrogen) for a few days before operation is of great assistance

If there is an ulcer on the tongue, its surface may be dried and touched with a pledget of cotton wool or a brush dipped in pure phenol or 20 per cent chromic acid but care must be taken that none spreads beyond the ulcer This treatment may be repeated twice a day

To enable cases with painful foul mouths to be improved within a few days Marriott recommends that, every two hours when the patient is awake, and at least every four hours during the night, the mouth should be thoroughly sprayed with a 1 in 2,000 solution of Nupercaine in glycerine, about half an ounce of the solution being used each time This renders the mucous membrane sufficiently anæsthetic for the patient to tolerate vigorous swabbing Advantage is taken of this oral anæsthesia for feeding the patient, and liquid nourishment is now given Every part of the mouth is thoroughly swabbed with a 50 per cent solution of hydrogen peroxide, and then re swabbed with citric acid solution 10 grains (650 mg) to an ounce of water Soft swabs held in forceps should be used and every corner of the mouth reached The mouth is irrigated with one part of eusol to three parts of water The irrigation is carried out by means of a catheter attached to a funnel

PREPARATION OF THE SKIN For operations on the mouth or tongue the area of skin to be prepared extends from the cheek bones to the clavicles on both sides of the body

After-treatment POSITION Immediately after the operation the patient is placed well over on his side so that the blood and mucus may run out of the mouth The nurse should wipe away the mucus and blood from his lips but she should not insert any swabs into the mouth otherwise any sutured mucous membrane may be injured

As soon as any shock has passed off and the patient has come round from the anæsthetic he should be well propped up with pillows or supported by a bed rest

The patient should be confined to bed as little as possible and whilst asleep he should lie on the affected side with his head turned towards that side

FEEDING The patient should be fed after the operation by means of a feeder with three inches of rubber tubing attached to the nozzle

in a covered vessel until again required Prior to insertion for the next meal the plate is thoroughly washed with sterile water

Time and Aim of Operation There is now a tendency to operate on a cleft palate before the age of one year The operation may be performed in two stages, but the surgeon will aim to have the operative treatment completed before the child attempts to talk At operation the gap in the palate is closed and the soft palate is lengthened so that it is possible to shut off the nasopharynx when necessary

Preparation The mouth should be cleansed by swabbing with glycerine of borax or in older children, by spraying with peroxide of hydrogen Carious teeth should be extracted or filled

After treatment POSITION AFTER OPERATION The child should be so placed that the saliva blood and mucus dribble out of the mouth and do not enter the larynx

On the second day he may sit up in bed and should be given books and toys to keep him as interested as possible

QUIETNESS Everything possible must be done to prevent the child from vomiting crying or coughing Older children are instructed not to talk and if they can write they are given a slate and pencil

FOOD Nothing should be given by mouth until the nausea has passed off and then only those foods not requiring mastication, such as milk soups jellies etc and these are persisted in until the stitches are removed All feeds and feeding utensils should be sterilized

CLEANLINESS After each feed the child should be given a drink of sterilized water or be made to rinse his mouth out In older children the mouth may be syringed out several times a day or sprayed with some mild antiseptic such as peroxide of hydrogen but this should not be persisted in if it frightens the child

STITCHES Stitches are removed from the palate on the eighth to tenth day

If the stitches are to be removed a long pair of scissors (blunt pointed) and a long pair of forceps are sterilized The child with its mouth kept open by a mouth gag is held with its head over the edge of the bed

In young children an anæsthetic is not infrequently necessary

VOICE TRAINING AND BREATHING EXERCISES These are exceedingly important items in the after treatment

Special Complications PERSISTENT VOMITING This is due partly to the anæsthetic and partly to the swallowing of blood It may often be arrested by a drink of weak bicarbonate of soda solution

HÆMORRHAGE AND SHOCK Persistent oozing of blood sometimes occurs and should be treated by applying pressure against the palate by means of gauze plugs

INFECTION Suppuration around one or more of the stitches occasionally occurs and then the wound may break down

operation, is allowing a Penicillin pastille to dissolve in the mouth every two hours

During the first few days it is important to keep the dressings on the neck unsoiled, and a piece of jaconet may help to protect them

Special Complications of Mouth Operations ASPHYXIA If it is feared that the tongue will fall backwards and obstruct respiration, the surgeon will place a strong thread through it The end of the thread is fixed to the cheek and can be pulled upon if necessary

INHALATION PNEUMONIA This results from the sucking of blood and secretions into the trachea To help avoid this, the patient is placed well over on his side so that these fluids can escape freely from the mouth Also, in this regard it is important to attend to the hygiene of the mouth *before* operation and to attend to the posture and feeding of the patient afterwards

Occasionally, asphyxia from œdema of the larynx or inhalation of blood or mucus appears likely, and then a tracheostomy will be performed at the end of the operation on the mouth or tongue

HÆMORRHAGE This may be either reactionary hæmorrhage occurring shortly after the operation or secondary hæmorrhage which occurs after seven to ten days

To control the bleeding until the surgeon comes the nurse should make the patient sit up and, if possible, she should maintain firm pressure on the bleeding point with a piece of gauze on a sponge-holding forceps Oxycel on the gauze may help If the bleeding persists and the patient will not open his mouth voluntarily a gag will be used An index finger may then be passed down behind the stump of the tongue to hook it forward so as to compress its arteries against the lower jaw

The end of the tube is passed to the back of the throat and the feeder gently tilted up However, if the patient cannot readily swallow he should be nasal fed for the first few days, that is, through a tube or catheter passed along the floor of the nose into the œsophagus or stomach Some surgeons prefer this method of feeding for the first week after all operations on the mouth and tongue

The tube and the feeding cup must be sterilized before use and all fluids used should be sterile

CLEANLINESS The field of operation and also the entire buccal cavity should be regularly cleansed at short intervals in order to reduce infection This may be carried out by various methods —

Syringing By this means the mouth can be very effectually cleansed without any great discomfort to the patient

A useful method is to suspend a douche can near the head of the bed a few inches above the level of the mouth

The patient then takes the nozzle, places it in the mouth and allows the antiseptic fluid to run while he bends his head over a basin By this means the patient can not only direct the stream where he wishes but by pinching the tube is also able to regulate the flow

This should be carried out frequently during the first few days after which the patient may rinse his mouth out for himself in the ordinary way

The best solutions are either a weak solution of peroxide of hydrogen or bicarbonate of soda (ʒi to the pint) in Normal saline If the odour is offensive a half to one per cent solution of liquor formaldehydi may be substituted

Suction It is a great help to the patient to have a sucker continuously available so that he can suck the saliva out of his mouth without calling a nurse each time This also overcomes the need for spitting which may be painful and because of the pain he is often unable to swallow the saliva

If fluid is drawn into the lungs and bronchi from the mouth and pharynx during inspiration this will surely lead to an inhalation pneumonia

Swabbing If respiration is embarrassed or if much of the fluid is swallowed after syringing the mouth may be swabbed with pieces of lint soaked in an antiseptic such as —

Formaldehyde solution	1 part
Glycerine	12 parts
Water	12 parts

Spraying Spraying the buccal cavity with an atomizer is an efficient method of cleaning it

A useful adjunct for controlling infection both before and after

orally, the dose of thiouracil is up to 0 2 gramme thrice daily As a result of this medication the signs and symptoms of the thyrotoxicosis slowly subside If operation is not performed, these drugs have to be continued for months or years This has the disadvantage that they themselves may produce symptoms of poisoning, such as agranulocytosis In some cases these drugs have produced an apparent cure of the thyrotoxicosis but relapses are common In other cases they



Fig 226 *One method of fixing the dressing after thyroidectomy*
The back ends of the adhesive strapping are usually fixed over each scapula but occasionally a single piece of strapping is used and then a piece of gauze should be applied over the back of the neck so that the hair will not stick to the strapping

do not completely control the thyrotoxicosis but even so they do provide an efficient means of preparing the very toxic cases for operation

Thiouracil increases the vascularity of the thyroid gland and with it the difficulties of the operation, but this may be counter acted by the administration of iodine for the week or two preceding operation In the less toxic case there is no need for thiouracil prior to operation, and on admission to hospital the patient will be started on iodine immediately The dose of iodine prescribed prior to opera tion is Lugol s iodine ♏ iii–x thrice daily Thiouracil is of great value in the severely toxic case for the effect of iodine diminishes after a fortnight whereas in severe cases many weeks of pre operative prepara tion may be necessary to fit the patient for operation Most surgeons prefer methyl thiouracil or propyl thiouracil in place of thiouracil but it should be noted that the dose of each of these two derivatives is slightly less than that of thiouracil

The thyrotoxic patient is ready for operation when the symptoms have subsided when the pulse rate and the basal metabolic rate have returned to normal and when there is an increase in weight

Some surgeons have practised stealing the thyroid that is, the patient is not advised of the date of the operation but is given a rectal injection of saline daily and then on the day of the operation paraldehyde or Avertin (bromethol) is substituted for the saline Accordingly

CHAPTER 21

THE THYROID GLAND, BREAST AND ADRENAL GLANDS

OPERATIONS ON THE THYROID GLAND

An enlargement of the thyroid gland is usually referred to as a goitre The operations performed on the thyroid gland are —

Total thyroidectomy or removal of both the lobes and the isthmus

Subtotal thyroidectomy which consists of the removal of part of one lobe plus the removal of the whole or part of the other lobe

Hemithyroidectomy or removal of one lobe

Resection of part of one lobe containing a localized lesion

Diseases of the thyroid gland are more common in women

An operation on the thyroid gland may be required because of —

1 Thyrotoxicosis This is manifested by nervousness insomnia loss of weight tremor hot flushes sweating palpitations, tachycardia increased metabolic rate and perhaps exophthalmos

2 Pressure on neighbouring structures If the pressure is on the trachea breathing becomes difficult if it is on the recurrent laryngeal nerve there is an alteration in the voice

3 Lesions such as a cyst or an adenoma If these are left they may give rise to complications later

Preparation for Operation If there is no evidence of toxicity the preparation does not differ from that of other operations on the neck

The pre operative preparation of a case of thyrotoxicosis however necessitates complete rest in bed the elimination of foci of infection and medication with sedatives iodine thiouracil or one of its deriva tives, or with Neo Mercazole

Radioactive iodine is used in some special clinics but its use is still in the experimental stage

The pre operative diet should be of high calorific value up to 5 000 calories in the twenty four hours and preferably consisting of 70 per cent carbohydrate 25 per cent protein and not more than 5 per cent fat The intake of fluids is increased as far as possible

With rest in bed medication and such a diet the patient should gain weight

The administration of thiouracil and its derivatives slow the rate of formation of the thyroid hormone and they are of value in preparing the patient for operation Thiouracil and its derivatives are given

orally, the dose of thiouracil is up to 0 2 gramme thrice daily As a result of this medication the signs and symptoms of the thyrotoxicosis slowly subside If operation is not performed, these drugs have to be continued for months or years This has the disadvantage that they themselves may produce symptoms of poisoning, such as agranulo cytosis In some cases these drugs have produced an apparent cure of the thyrotoxicosis, but relapses are common In other cases they



Fig 226 One method of fixing the dressing after thyroidectomy
The back ends of the adhesive strapping are usually fixed over each scapula but occasionally a single piece of strapping is used and then a piece of gauze should be applied over the back of the neck so that the hair will not stick to the strapping

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The thyrotoxic patient is ready for operation when the symptoms have subsided when the pulse rate and the basal metabolic rate have returned to normal and when there is an increase in weight

Some surgeons have practised stealing the thyroid, that is, the patient is not advised of the date of the operation but is given a rectal injection of saline daily and then on the day of the operation paralde hyde or Avertin (bromethol) is substituted for the saline Accordingly,

the patient goes to sleep in bed and is then prepared and taken to the operating theatre This method was of some value when it was not possible to control the toxicity before the operation but with present day treatment the toxicity may be controlled, and it is preferable for the patient to have complete confidence in the surgeon and nursing staff so that she is looking forward to being cured by the operation

Surgeons and anæsthetists vary as regards the choice of anæsthetic for thyroidectomy, but ether, nitrous oxide or cyclopropane give very good results if the toxicity has been controlled Local anæsthesia may be used and is preferred by some surgeons Recently, Pentothal with pethidine and a relaxant have been widely used by the specialist anæsthetists

In patients who are still nervous and worried some form of pre anæsthetic drug such as a rectal injection of paraldehyde (up to ʒi per stone of body weight with a limit of ʒvii), is of value

One of the causes of death after thyroidectomy is liver failure The risk of this is somewhat decreased by a pre operative diet containing large amounts of dextrose and proteins

Position of the Patient during Operation The shoulders are raised on a sandbag and the head is thrown back but it must still be resting on the table

After-treatment POSITION As soon as the patient has come round from the anæsthetic she should be propped up in bed by pillows or a bed rest This position decreases any oozing of blood in the wound, it increases the patient s comfort and it helps respiration

CHEST AND HEART In bad risk cases of thyrotoxicosis in whom cardiac or pulmonary complications are likely, the post operative inhalation of warmed oxygen is a wise precaution If a 'B L B" or other mask is not available a catheter of not less than 6 millimetres in diameter should be inserted through the nostril as far back as the nasopharynx fixed with adhesive strapping to the forehead or cheek and connected with an oxygen supply The latter should have a flow meter and at least 5 litres per minute are given

In cases who showed severe thyrotoxicosis there may be a sharp rise of pulse rate which starts during the operation reaching a maximum in from six to forty eight hours and then gradually falling to the pre operative ratio within three or four days

Patients with auricular fibrillation and thyrotoxicosis have a normal cardiac rhythm restored in at least 80 per cent of cases after thyroidectomy

THIRST After thyroid operations and especially those for thyro toxicosis, it is advisable to give the patient large quantities of fluid, *i e* up to eight pints in twenty four hours

FOOD For the first two or three days liquid food only is often advisable because of pain on swallowing

DRESSINGS The drainage tube, if any, should be removed in twenty four hours whilst the stitches or clips are usually left till the second third, or fourth day

GETTING UP The patient usually gets up on the second day, and after that spends several hours out of bed daily

Patients who have had acute thyrotoxicosis (Graves disease) should be kept in bed longer and none in this latter group should be permitted to resume her normal occupation within two months and then only when it is definitely established that the main subjective and objective features of the disease have been overcome

Complications of Thyroid Operations REACTIONARY HÆMORRHAGE After the patient has been put back to bed following the operation severe reactionary hæmorrhage may occur if a ligature or clot is displaced Such an occurrence is rare but it is imperative that it is recognized and reported immediately

The bleeding may be partly external escaping *via* the wound, or concealed, forming a hæmatoma in the loose tissues of the neck and pressing on the trachea Hæmorrhage demands immediate opening up of the wound and ligation of the bleeding point To prevent hæmorrhage the patient s head should be elevated and kept as still as possible and all straining should be avoided

SHOCK This is similar to shock occurring after other operations

RESPIRATORY OBSTRUCTION Difficulty with breathing (dyspnœa) after operations on the thyroid gland may be due to (a) Hæmorrhage into the wound which is treated by immediate evacuation of the blood from the wound and by the ligation of the bleeding point and (b) Spasm or paralysis of the vocal cords due to injury to the recurrent laryngeal nerves This may occur at or soon after the operation and is indicated by a rising pulse and respiratory rate, by noisy respirations (stridor) and later by cyanosis and indrawing of the epigastrium Treatment consists of the insertion of a wide bore rubber tube through the larynx (intubation) or the performance of a tracheostomy

Any respiratory distress must be reported immediately to the medical officer as death may occur in a few minutes if it is not relieved

Amethocaine hydrochloride (Decicain) to make a 1 per cent solution a de Vilbiss or Magill s spray a laryngoscope Magill s intubation forceps and intratracheal rubber tubes should be readily available after operations on the thyroid gland in case they are urgently required

CARDIAC FAILURE Many patients with thyrotoxicosis have damage to the heart muscle and it is not surprising that some of them develop cardiac failure after operation If not already irregular due to auricular fibrillation the pulse may become so Also there may be the appearance of œdema of the dependent parts, and the patient may become

increasingly distressed and eventually cyanosed She should be well propped up in bed and have everything done for her by the nurses Digitalis in the tincture or other form will probably be ordered by mouth or intravenous injections of digoxin may be given

ACUTE THYROID CRISIS This may come on in the first twenty four hours after operation in cases suffering from thyrotoxicosis usually when they are insufficiently controlled before operation It is alleged to be due to the absorption of thyroid secretion from the wound and to acute liver failure

The symptoms resemble somewhat those of severe acute sepsis The temperature rises to 104 or more degrees Fahr, the pulse and respiratory rates are rapid and the patient becomes restless and delirious Diarrhœa vomiting and even jaundice may occur

The patient with a developing or established thyroid crisis should be nursed in a quiet ward and restlessness overcome by sedatives An adequate intake of fluid and sugar is essential either orally or by intravenous injection Pneumonia may develop and this is an added reason for nursing in Fowler s position Lugol s iodine (♏xxx) may be given orally if the patient will swallow or if not fifteen to thirty grains (1 to 2 grammes) of sodium iodide in a pint of 5 per cent dextrose solution may be injected intravenously (It is to be noted that it is not usual to give iodine after thyroidectomy as it is only necessary in treatment to atisfy an over active thyroid gland) If there is evidence of cardiac failure, 0 5 mg of digoxin may be given intravenously Owing to the greatly increased metabolic rate the tissues require more oxygen and this should be administered continuously as soon as the condition is suspected In order to reduce the temperature and the metabolic rate tepid sponges are advisable

The patient who has developed or who shows signs of developing a thyroid crisis requires even more careful nursing attention than other patients after thyroidectomy

APHONIA or loss of voice This may follow injury to the recurrent laryngeal nerve and the voice will then be reduced to a whisper Its onset may immediately follow the operation or it may occur later due to pressure on the nerve by the scar tissue

In some cases a temporary change in the voice may occur due to an injury to an external laryngeal nerve or to a cricothyroid muscle

TETANY The patient develops tetanic contractions of the hands and feet and these later spread to other parts of the body

These symptoms are due to accidental removal of the parathyroid glands or to interference with their blood supply These glands lie in close proximity to the posterior surface of the thyroid gland and as a result of the absence of their secretion there is a decrease in the calcium of the blood

Although the association of the above glands with calcium metabolism is now well established, no fixed figure can be given for the exact tetany level of serum calcium, but a figure round about 7 mg per 100 ml may be taken as the critical level below which tetany may be expected

The intravenous injection of 10 to 20 ml of 10 per cent calcium gluconate controls the symptoms for a few hours Parathyroid hormone in doses of 1 ml (20 units) intramuscularly produces a rise in the serum calcium after five or six hours, two or three injections of parathyroid hormone may be required on the first day but thereafter daily injections usually suffice In the majority of post operative cases the administration of calcium or parathyroid hormone is only necessary for a few days In the more unusual case in which the tetany persists, the daily injection of the parathyroid hormone is supplemented by a high calcium diet *e g* milk and milk products Unfortunately parathyroid hormone is expensive, it becomes less effective with continued use, and it depletes the bones of calcium

Surgical implantation of parathyroid tissue has been tried but it has not been attended with lasting success owing to degenerative changes in the implant

Dihydrotachysterol (A T 10) is closely allied to vitamin D When given orally in doses of 5 mg in 1 ml of an oily solution together with calcium the serum calcium level is restored to normal and the tetany is relieved This type of treatment may be continued almost indefinitely if the dose of the dihydrotachysterol is carefully controlled by repeated estimations of the calcium level of the serum If the dose of the drug is larger than is necessary the serum calcium rises above the normal level (9–11 mg per cent) the patient becomes listless and may eventually become unconscious The maintenance dose of dihydrotachysterol should be estimated and the patient kept on this and on a high intake of calcium

MYXŒDEMA This occurs if the whole thyroid gland is removed and if the patient fails to continue with regular thyroid medication The face becomes swollen puffiness of the eyes and swelling of the abdomen occur and the hair is dry and brittle The patient becomes pale and lethargic with marked slowness of movement and thought There is a subnormal temperature in the later stages

Regular thyroid medication is essential and the dose is usually 1 to 3 grains (65 to 195 mg) of thyroid extract per day Careful supervision is necessary to detect increasing myxœdema or signs of toxicity due to overdosage

SEPSIS If the wound becomes inflamed chemotherapy will be employed If the infection extends deeply into the neck despite the chemotherapy and this is most exceptional the wound will be opened and drained

OPERATIONS ON THE BREAST

LOCAL EXCISION OF A LUMP in the breast This is performed when it is considered that the lump is due to a cyst or to a simple tumour and also in cases of doubt in order to allow the pathologist to prove the presence of cancer before a radical mastectomy is performed

SIMPLE MASTECTOMY This operation consists of a removal of the breast but not of the axillary contents It is performed for intractable pain in the breast and in cases of cancer of the breast where any axillary metastases are being especially dealt with by radiotherapy It is also performed in frail, old women with a cancer of the breast but who would not endure a more extensive operation

PLASTIC OPERATIONS on the breast These are usually performed in cases of huge pendulous breasts to reduce their weight

RADICAL MASTECTOMY Radical mastectomy is performed for cancer of the breast It consists of the removal of the breast and its skin the two pectoral muscles, the axillary fat and lymph glands and the fascia of the axilla and chest wall

Preparation The special preparation for excision of the breast relates to the purification of the skin The cleansing should not be limited to the breast and axilla but must include the skin of the neck, shoulder and arm the chest and back extending from the opposite breast to the backbone and from the neck to the umbilicus

Position of the Patient during Operation During the operation the arm of the affected side wrapped in a sterile towel is held abducted by a surgically clean nurse or is supported on an arm rest fixed to the side of the operating table If the former procedure is adopted, the nurse must be very careful especially after the pectoral muscles have been divided not to over abduct or over extend the patient s arm otherwise partial paralysis of the limb may arise, owing to excessive stretching of the nerves comprising the brachial plexus

When a large area of skin is involved it is sometimes found at the termination of the operation that it is impossible to bring the edges

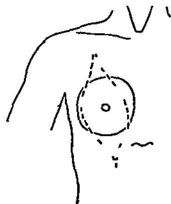


FIG 227 Diagram showing the incisions for radical mastectomy (heavy interrupted line) and the extent of the dissection (light interrupted line)

of the wound into apposition, the raw area left may then be covered with skin grafts taken from the patient s thighs If the wound is closed under tension, this may be relieved by multiple short incisions running parallel to the wound

Most surgeons drain the axilla by introducing one or more tubes through its posterior margin the tubes should be about half an inch in diameter and two or three inches in length

In some cases the drain tube will be connected to a suction apparatus in an attempt to drain away the lymph, but occasionally the air is evacuated from the wound and it is closed without drainage

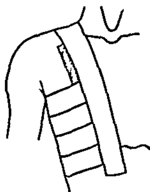


Fig 228 A method of fixation of the dressing after a radical mastectomy using elastic adhesive strapping (Elastoplast)

The large skin area is cleansed at the end of the operation and a liberal dressing applied over the upper arm, the chest and back Extra pads of wool are placed *in the axilla to provide pressure and lest* there is any oozing

After-treatment of Amputation of the Breast POSITION As soon as the patient has recovered from the anæsthetic she should be propped up in bed in a sitting position in order to prevent atelectasis, broncho pneumonia and other chest troubles

POSITION OF THE ARM The surgeon may bandage the patient with the arm abducted to a right angle It should then be kept in this position the elbow being flexed and the pronated forearm supported on a pillow If the patient is unduly restless the upper arm may be secured to the head of the bed by a small sling In other cases the arm will be kept by the side for a day or two and then active movements commenced

DRESSINGS There is sometimes some oozing of blood through the dressings in the first twenty four hours When this happens more wool should be packed on the site where it occurs The wound should not be re dressed unless the oozing is considerable

At the end of forty eight hours any drainage tubes are removed and a fresh dressing is applied This is changed as required and the sutures are removed on the eighth to tenth day

MOVEMENTS OF THE ARM Much of the stiffness and limitation of movement of the arm will be prevented if movements of the shoulder are commenced early After the third day it is advisable to encourage *the patient to use the arm as much as possible If this is followed by* a collection of serum beneath the wound margins it is removed by aspiration If the patient practises outward and upward movements of the shoulder from the third day, she should obtain full movement

GETTING UP After the fourth day the patient should, if possible be moved into an armchair and should spend an hour or more out of bed daily

Complications after Amputation of the Breast COLLECTION OF SERUM IN THE WOUND

SHOCK During operation the continued exposure of a large area of the wound and loss of blood may lead to shock

SLOUGHING OF THE SKIN When a large area of skin has been removed tension may result if apposition is secured and this may cause sloughing of the wound edges

LUNG AFFECTIONS Lung complications such as pneumonia, are liable to develop owing to the shallow respirations Movements of the chest may be impeded because of pain in the wound and tight bandaging

SEPSIS This is a very serious complication after amputation of the breast and may lead to scarring and limitation of movement of the arms

ŒDEMA OF THE ARM If it occurs very early this is due to injury to or thrombosis of the axillary vein but later it is due to obstruction of the lymphatics by cancerous deposits or by scar tissue

ADRENALECTOMY

Unilateral Adrenalectomy Removal of one adrenal (suprarenal) gland is occasionally required because of a simple or malignant adrenal tumour Some but only some of these tumours produce hormones *which alter the growth and sexual development of the patient or cause* variations in the blood pressure Other adrenal tumours which produce no hormone cause pressure on neighbouring structures or if they are malignant give rise to local and distant spread of the growth

In some cases of unilateral adrenal tumours it is found that the gland containing the tumour is the only functioning gland Sometimes adrenal tumours are bilateral

If all functioning adrenal tissue is removed *adrenal shock* will develop This usually starts within the first twenty four hours and consists of a fall in blood pressure weakness lethargy developing into coma, and changes in the electrolytes of the body fluids, such as low blood sodium and high blood potassium levels Once this condition has been allowed to occur it is very resistant to treatment but if it is

anticipated and cortisone started a day or so before the operation there is usually quite a smooth post operative course Thus cortisone should be given as described below whenever there is any possibility that an adrenal tumour will be removed If all the functioning adrenal tissue is not removed, the cortisone can be gradually diminished a few days after the operation

Bilateral Adrenalectomy This may be a total or a subtotal procedure that is all the adrenal tissue is removed or a small part of one or both glands is allowed to remain Bilateral adrenalectomy is performed for the removal of bilateral tumours, in cases of Cushing s syndrome and in the management of extensive cancer of the breast In most cases of CARCINOMA OF THE PROSTATE a beneficial effect is obtained by the exhibition of stilbœstrol, with or without castration In some of the other cases a newer type of œstrogen TACE (chlortrianisene) is helpful

In the past eight years bilateral adrenalectomy has been performed in some of those cases of carcinoma of the prostate in which the response to the œstrogens was unsatisfactory but more recently it has since been found that similar results may be obtained with large doses of cortisone Even so, these results are usually no better than with stilboestrol

Subtotal bilateral adrenalectomy was performed for a time for the treatment of *Cushing s syndrome* in which there is an overactivity of the adrenal glands However it is often impossible to determine the correct amount of gland tissue to remove to prevent further signs or symptoms due to overfunctioning of the gland and at the same time to leave sufficient gland tissue to avoid the need for cortisone administration Since it is now easy to maintain patients after total adrenalectomy this is the operation more often used in the treatment of Cushing s syndrome

Cancer of the Breast

Some cases of cancer of the breast are affected by the administration of sex hormones and some by operations which deprive the body of these hormones

The administration of male or female hormones slows the rate of growth of some but not all breast cancers When there is little or no response to these hormones and when there is severe pain due to metastases in the bones the removal of all sex hormones from the body is indicated In about half the patients this will relieve the pain and will result in improvement in the general condition

The removal of the pituitary gland (hypophysectomv) does away with the normal stimulation to the adrenal glands and to the ovaries so that then no sex hormone is produced (In both sexes small amounts of both male and female hormones are formed in the adrenal glands) Unfortunately hypophysectomy is a difficult and dangerous

operation and cannot be advised as a routine in patients who have extensive metastases from a cancer of the breast

The removal of both ovaries and both adrenal glands (bilateral oophorectomy and bilateral adrenalectomy) is less difficult and less dangerous than hypophysectomy and in very poor risk cases it may be carried out in two or even three stages Usually the ovaries and one adrenal gland are removed at the first operation and then about two weeks later the second gland is removed Since the other adrenal gland may have been destroyed by metastases cortisone should be commenced prior to the first stage

Preparation for Bilateral Adrenalectomy These glands may be approached through the beds of the 11th and 12th ribs through incisions in the lumbar regions similar to those used for approaching the kidneys or through incisions in the anterior abdominal wall The skin of all these areas should therefore be prepared

Replacement Therapy With bilateral adrenalectomy this should as already mentioned commence 24 to 36 hours before operation and a useful scheme to follow is that of Huggins who was the originator of this operation Huggins recommends —

Day Pre Op	Cortisone 50 mg I M I at 6 a m 12 midday 6 p m and 12 midnight Desoxycorticosterone acetate (D O C A) 5 mg I M I at 9 a.m Salt (NaCl) 4 grammes at 6 p m Nothing by mouth after midnight
Day of Op	Cortisone 150 mg I M I } 1 hour pre op D O C A 5 mg I M I } During operation—1 pint of blood plus 5 per cent dextrose in Normal saline Immediately after operation—Cortisone 50 mg. I M I and then 4-hourly Penicillin 100 000 units I M I and then 4 hourly Fluids Slow intravenous infusion of 5 per cent dextrose in Normal saline 1 litre and 5 per cent dextrose in water 1 litre Definitely not more than $2\frac{1}{2}$ litres should be given Blood transfusion if needed Fluids by mouth and encourage patient to drink Pethidine HCl 50 to 75 mg. 4 hourly Adrenalectomy patients are often sensitive to sedatives Blood pressure pulse and respiratory rates taken every ten minutes after operation This interval can be lengthened on judgment.

Temperature taken every two hours and aspirin given if high
Urinary output measured hourly by an indwelling catheter

1st day after Op i e DO+1
Cortisone 50 mg I M I 6 hourly
D O C A 5 mg at 9 a m
If drinking well and a good urinary output, the intravenous infusion is discontinued
B P, P, R hourly or 2 hourly, using judgment
T 4 hourly

DO+2
Cortisone 50 mg I M I 8 hourly
D O C A 3 mg I M I using judgment
Regular diet
Start NaCl 1 gramme orally 6 or 8 hourly
Catheter removed
Patient up and in chair

DO+3
Cortisone 50 mg I M I twice a day
Patient should be out of bed
Blood pressure, pulse 4 hourly
NaCl 1 gramme thrice daily

DO+4
Cortisone 25 mg I M I thrice daily
NaCl 1 gramme thrice daily

DO+5
Cortisone 25 mg twice daily orally
Sedatives given on judgment
NaCl 1 gramme twice a day

DO+6
Cortisone 25 mg twice a day orally
Penicillin discontinued
NaCl 1 gramme twice a day

DO+7
Cortisone 25 mg twice a day orally
NaCl 1 gramme twice a day

DO+8
Corsitone 25 mg in a m and 25 mg in p m (50 mg cortisone orally is the maintenance dose)
NaCl 1 gramme twice a day (maintenance dose)
D O C A is indicated in patients with orthostatic hypotension

The patient (and his relatives) should be warned of the great dangers of not continuing this maintenance dose of cortisone

If a mild respiratory or other infection develops, if there is loss of appetite or if the patient feels weak an extra 25 mg tablet should be taken daily If this does not produce considerable improvement a medical examination is indicated

After bilateral adrenalectomy the patient should always carry a card with (a) his or her name and address
(b) the date of the adrenalectomy
(c) the diagnosis and
(d) the daily dose of cortisone

Complications after Bilateral Adrenalectomy

ADRENAL SHOCK This will be recognized in the early stages by a fall in the blood pressure, and it should respond to an extra injection of 50 mg of cortisone In severe cases of adrenal shock noradrenaline may be ordered in addition

PATHOLOGICAL FRACTURE The bones of these patients may be very fragile due to metastases and absorption of calcium, and they require handling with special care both during the operation and afterwards lest a fracture is caused by even slight trauma

CHEST COMPLICATIONS Since the operation involves the chest wall or the upper abdomen, chest complications are a possibility due to interference with the depth of respiration Respiratory exercises should be started early

HICCOUGH Interference with the diaphragm during the operation may cause hiccoughs afterwards

ADRENAL INSUFFICIENCY This causes nausea, vomiting weakness loss of appetite and fever, and may occur at any time after operation It will certainly occur if the cortisone is not taken regularly or if an infection develops It is an indication for more cortisone

HOT FLUSHES These are common but are not important

ŒDEMA This is due to water retention and is usually corrected by reducing the intake of salt

CHAPTER 22

THE THORAX

Operations performed within the Trachea and Bronchi Broncho scopy with aspiration or biopsy (See Chapter 35)

Operations on the Chest Wall Intercostal drainage and rib resection for empyema Exploratory thoracotomy Thoracoplasty

Operations on the Lungs Pneumonectomy Lobectomy Segmental resection

Operations on the Heart and Great Vessels Cardiac catheterization Drainage of the pericardium Pericardiectomy Correction of per sistent ductus arteriosus and of other congenital defects Mitral valvulotomy Pulmonary embolectomy (see Chapter 23) Cardiac massage (see Chapter 13) Aortic graft

Preparation for Operations on the Thorax Nutritional deficiencies are corrected as far as possible by an attractive easily digested high caloric diet Any deficiencies of vitamins and electrolytes are replaced and if necessary a blood transfusion is given

Respiratory movements are practised with the help of a physio therapist

A baby or small child will be accustomed to the oxygen apparatus which may be required after operation

Coughing is encouraged and if the sputum is copious, postural drainage is also used

Penicillin or other antibiotics are given for at least two days If the patient is suffering from tuberculosis, sodium para aminosalicylate (PAS) streptomycin and isoniazid (INH) will be given for at least two months before operation unless it is an emergency one

If there is gross infection of the nasal sinuses this will be reduced by washing out the antra Operations on the nasal sinuses are usually deferred till after the operations on the lungs if both are required because the sinuses are likely to be reinfected by the infected sputum

Usually a bronchoscopic examination and aspiration of bronchial secretions is performed before commencing an operation on the lungs

Digitalis is sometimes given for several days prior to operation on the lungs and heart when cardiac irregularities such as auricular fibrillation are likely

If an anastomosis of the large vessels is to be performed the intake of fluids is increased to lessen the risk of thrombosis

Anæsthesia Local anæsthesia is often used for drainage of an empyema thoracis, but, apart from that, general anæsthesia with controlled respiration through an intratracheal tube is usually necessary for operations on the thorax

Position of the Patient during Operation Many positions are used depending on the site of the incision or incisions but the commonest are the lateral (the incision being just below the scapula) the antero lateral (the incision being in the 5th or 6th intercostal space through the bed of the 5th or 6th rib bed or a combined abdomino thoracic approach), or on the back (for anterior incisions)

The patient is firmly fixed on the table so that the site of the incision is readily available so that there is no interference with movements of the chest and so that the anæsthetist has access to the face and to the site of the transfusion

After-treatment Bronchoscopy is often performed at the end of the operation to remove any secretions or blood from the bronchial tree

The drainage tube is connected to a sterile underwater seal (Fig 232) and then the clip is removed An underwater seal is composed of a bottle with a glass tube passing down well below the surface of the fluid the upper end of this glass tube being connected to the drain tube in the chest The fluid in this bottle is changed daily but the tube must always be clipped off before the rubber tube is detached from the bottle Otherwise air will enter the pleural cavity and the lung will collapse Also the clip must not be released until the drainage tubing is again connected to the glass tubing leading below the surface of the fluid If the drain tube is blocked it should not be washed out as this may lead to fatal air embolism

Unless there is much drainage of air blood or chyle it is often possible to remove the drainage tubes and to discontinue the under water seal after forty eight hours Air should not be allowed to enter the wound after the tube is removed If a suture has been inserted for the purpose during the operation this will now be tied but if not the wound is covered immediately with a firm pad

In some cases it is necessary to aspirate fluid or air from the pleural cavity after the tube is removed

When conscious the patient is sat up to make coughing more effective and breathing easier Both coughing and breathing are encouraged by the nurses and the physiotherapist At first it may be necessary to support the wound with the hand whilst coughing

The rubber tubing to the underwater seal the glass tubing the inside of the bottle and the fluid should be kept sterile at all times

It is most important that the bottle containing the fluid is never lifted up to or above the level of the patient without first completely clipping off the drain tube If the bottle is lifted up above the patient

and the tube has not been clipped off, fluid may run back into the chest

Adequate doses of morphia or its derivatives are essential, otherwise it will be too painful to cough or breathe deeply On the other hand, these drugs should not be given in doses sufficient to depress respiration or coughing

The primary aim of the deep breathing and the exercises is to aerate and expand the lung tissue and thus obliterate the residual pleural space

Antibiotics should be continued for some days after operation on the chest in order to reduce the likelihood of infection which may be serious This especially applies after operations on the heart or large blood vessels as infection of the suture line may lead to its rupture

Complications of Chest Operations SHOCK

FRACTURED RIBS This is due to excess retraction

BLEEDING Bleeding may start after operation from an injured intercostal or internal mammary vessel

INJURY TO THE BRACHIAL PLEXUS Such an injury may be due to traction on the arm or to pressure during the operation

SURGICAL EMPHYSEMA OF THE CHEST WALL This soon settles down if the pleural cavity is being drained

ATELECTASIS (PULMONARY COLLAPSE) If the bronchial secretions are allowed to accumulate the air in the alveoli (air cells) becomes absorbed and that portion of the lung collapses Atelectasis is prevented by deep breathing and coughing A catheter may be passed down the trachea and suction applied but this is not as effective as bronchoscopic drainage, and is only used when the patient with atelectasis is exhausted or if *very frequent aspiration is required* Atelectasis is indicated by increased breathlessness and is confirmed by changes in the physical signs on examination of the chest and by X ray examination If atelectasis is allowed to persist it soon leads to infection and pneumonia Routine X ray examinations of the lungs are therefore indicated lest a patch of atelectasis is being overlooked

BRONCHOPNEUMONIA

LOBAR PNEUMONIA

EMPYEMA This may follow infection from the cut surface of the lung or bronchus, especially when blood has been allowed to remain in the pleural cavity The sooner the lung is re expanded and fills the pleural cavity the less chance there is that an empyema will develop

PAIN DUE TO AN INJURY OF AN INTERCOSTAL NERVE

CARDIAC FAILURE

EMPYEMA THORACIS

An empyema thoracis is a collection of pus in the pleural cavity and nowadays it is uncommon

Position The patient should sit up and lean forward if a broncho pleural fistula is present so that the pus will not enter the bronchi In other cases he may lie on the sound side (to help expand the compressed lung) or may sit up

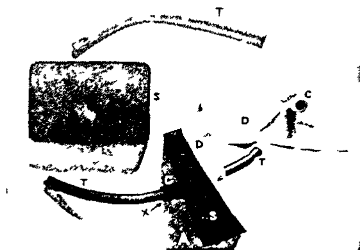


FIG 229 The assembled tube (A) and its component parts
S Rubber sponge T Chest tube D Dental dam gummed to collar (C) The tube (T) is strapped to the collar (C) at X after the length of the tube projecting beyond the dental dam is adjusted at operation to the needs of the case

Treatment At first the pus is aspirated and antibiotics are used, both by injection into the pleural cavity and by other routes The choice of antibiotic will depend on the results of sensitivity tests of the infecting organisms

If the infection is not controlled by aspiration and antibiotic therapy a drain tube which is temporarily clipped off will be inserted into the chest and connected to some suction apparatus the clip then being released The negative pressure used is about 30 cms of water

A Malecot or a de Pezzer catheter may be introduced through an intercostal space under local anæsthesia using a large trocar and cannula or a larger tube may be inserted after portion of a rib is resected The latter method is used if the intercostal tube causes much pain or if the pus is very thick Because of the risk of secondary infection open drainage is not used in the presence of a pure tuberculous empyema

The tube from the patient to the collecting bottle should be long enough to allow movement in bed without any risk of upsetting the bottle or of disconnecting it The up and down movement of the fluid from the bottle into the glass tubing indicates that the siphon system is working satisfactorily Before disconnecting the bottle for any purpose the tube must always be clamped

For continuous high negative pressure suction the apparatus described by Trethewie (Fig 229) may be used It consists of two pieces of

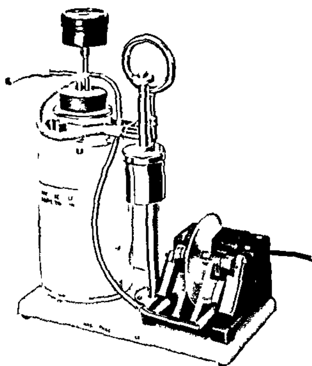


Fig 230 Roberts electric suction pump which consists of a noiseless pump a suction bottle a graduated vacuum gauge and an adjustable valve It will provide a negative pressure of up to 20 cm of mercury for long periods and the apparatus itself requires no attention beyond an occasional drop of oil on the bearings As with all suction apparatus the bottle should be emptied before there is any chance that the fluid in it will be aspirated into the pump

Needless to say the tubing from the chest must be clipped off before disconnecting the bottle and it should not be released again until (a) the bottle has been reconnected (b) the motor restarted and (c) the desired level of negative pressure attained Otherwise air will be aspirated into the pleural cavity and collapse of the lung will occur This pump is for use on alternating current only

pressure tubing a rubber sponge and a square of dental dam The inner or drainage tube is firmly fixed to the collar or outer tube (which perforates the centre of the sponge) by means of adhesive strapping

The region of the skin around the wound is smeared with zinc cream and the rubber sponge faced with the dental rubber which is glued to the outer tube, is then firmly fixed in position by adhesive strapping applied half way around the chest

An airtight connexion between the tube and the pleural cavity may also be obtained by the use of a rubber glove The end of the thumb is cut off the drainage tube passed through this hole and then the

tube is glued to the inside of the thumb of the glove After the tube is inserted, the remainder of the glove is flattened out on the chest wall and pressure applied to keep it there

Suction is secured by means of the pump from a Potain s aspirator or by an electric suction apparatus (Fig 230), at first at a pressure of 3 cm of mercury and daily increased until a negative pressure is obtained which appears to be the optimum for securing drainage This is usually less than 20 cm of mercury If the suction is increased too rapidly or if the negative pressure reached is too great, the patient will complain of discomfort hæmorrhage may occur from the pleura and the tube may be blocked by the lung

After about twelve to twenty days with little discharge, the open method of drainage may be substituted

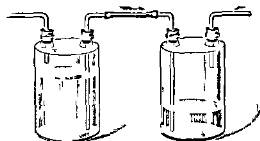


FIG 231 James apparatus

When the latter is employed frequent antiseptic dressings are necessary one of the best being gauze wrung out of Monacrin (1 in 1,000 solution) Until such time as the cavity is obliterated by expansion of the lung this tube should be removed cleansed, sterilized and re inserted daily

When the empyema first develops there is usually only one type of infecting organism and the chance of early eradication of the infection and of cure of the empyema is much greater if secondary infection is prevented Thus even if there is a copious discharge of pus every effort should be made to prevent infection with any other organism while the dressings and the tubes are being changed

The only reliable method of determining when an empyema cavity has healed is by radiological examination after injection of an opaque substance into the sinus Drainage tubes should be employed until any cavity deep to the ribs is completely obliterated

Filling up the cavity with penicillin or Monacrin solution and measuring the amount used (always provided there be no broncho pleural fistula) gives an estimate of the size but not of the shape or boundaries of the cavity By means of a weekly irrigation chart the progressive diminution in the capacity of an empyema may be graphically recorded

EXPANSION OF THE LUNG An empyema differs from other abscesses

in that it heals mainly by expansion of the lung and only partly by granulation Non expansion of the lung after empyema is a very serious complication, for it usually leads to deformity of the chest, a persistent discharging sinus, or secondary lateral curvature of the spine A great deal may be done to assist the lung to expand by

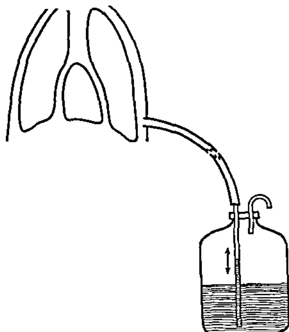


FIG 232 Diagram of an underwater seal

At the end of any operation in which the pleural cavity is opened a large rubber tube will be inserted into the pleural cavity and connected to a glass tube which passes well below the level of an antiseptic solution The wound is then closed This whole apparatus is of course kept sterile

employing suction drainage and by breathing exercises Whilst there is still an opening in the chest, the expansion of the lung should be encouraged by respiratory exercises under the guidance of a physio therapist The depth of respiration may be increased by an apparatus such as that of James (Fig 231) It consists of two bottles one filled with water joined together by glass tubing and so arranged that by blowing into one bottle the water is forced into the other Small bottles of about a pint capacity are used later two of a larger size may be substituted Five minutes blowing during each waking hour should not be too exhausting and suffices For children a trumpet or whistle that will not make a noise unless blown hard answers the purpose

When the wound has healed respiratory exercises should be continued and they should be continued in children for a long period

Until the lung is completely expanded weekly X ray examinations should be made

PROGRESSIVE DISINFECTION OF THE PLEURAL CAVITY Most of the organisms that cause empyema are susceptible to penicillin Thus it is often of great value in cases of empyema After aspiration of pus, penicillin is injected directly into the pleural cavity or along the drain tube and it is also given by intramuscular injections For direct instillation into the pleura the penicillin is prepared in the strength of 2,000 units per ml of Normal saline and 20 to 30 ml are injected daily until the discharge from the chest becomes sterile The dose for intramuscular injection is usually 100,000 units every three hours These latter injections have the added advantages of helping to eradicate any areas of pneumonia which are still present Cellulitis of the chest wall occasionally follows aspiration of an empyema but this is less likely with the use of antibiotics

When the drainage from the tube into the pleural cavity is not satisfactory it may be irrigated The fluid used for such irrigation soon after operation may be a warm solution of penicillin (2 000 units to the ml) Even in the absence of secondary infection, occasional irrigation with full or half strength eusol may help to dissolve fibrin clots that are blocking the drainage tube

Streptokinase Streptodornase are two enzymes which are available as a freeze dried powder They liquefy blood and fibrin clots After freshly preparing a solution with 10 ml of Normal saline, these enzymes may be injected into the pleural cavity in cases in which there is difficulty in draining an empyema They are also used for injection into clotted blood in the pleural cavity

In cases in which secondary infection has occurred the pleural cavity should be irrigated with the appropriate antibiotic to which the organisms are sensitive or with Monacrin solution (1/1,000)

GENERAL TREATMENT Owing to the loss of protein in the pus it is necessary for the patient to receive an added intake of protein This may best be given by adding drinks made from dried skim milk and eggs to the diet which should be easily digestible The daily caloric intake should be at least 3 000 Calories An increased fluid and vitamin intake is also necessary Pains in the chest require treatment by suitable analgesics so that respiration is not inhibited Purgation with its accompanying discomfort and dehydration should be avoided

Complications of Empyema CHRONIC EMPYEMA When the lung does not expand a chronic abscess cavity is left between the lung and chest wall the wound does not heal and a discharging sinus persists The full extent of the cavity should be determined by X ray examination aided by the injection of a radio opaque fluid such as lipiodol

The greatly thickened pleura may be removed by the operation of decortication and this may allow the lung to re expand

A PERSISTING DISCHARGING SINUS This may be due to osteo

myelitis of a rib, to failure of the walls of the empyema cavity to *come together*, to the development of a bronchial fistula, to the presence of a foreign body such as part of a drain tube, or to a tuberculous infection of the pleura

CELLULITIS OF THE CHEST WALL

EMPYEMA ON THE OPPOSITE SIDE OF THE CHEST

CEREBRAL ABSCESS This is a rare complication of empyema

LATERAL CURVATURE OF THE SPINE

EXPLORATORY THORACOTOMY

If after an exploratory thoracotomy the condition is found to be inoperable, the wound in the chest wall will usually be closed and the post operative management will be similar to that after other major operations

LOBECTOMY, PNEUMONECTOMY AND SEGMENTAL RESECTION OF LUNG TISSUE

These operations are performed for the treatment of infections of the lung, *e g* bronchiectasis lung abscess, tuberculosis, and for the treatment of cysts and tumours of the lung

Pre-operative Preparation The pre operative preparation is most important and is described above

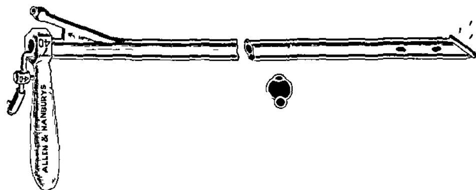


FIG 233 Chevalier Jackson s aspirating bronchoscope

Position of the Patient during Operation Usually the patient is placed on the opposite side with the arm of the affected side supported on an arm rest The *incision is often* made along the 5th or 6th rib which is resected

After treatment During the operation a *transfusion is maintained* and this is continued afterwards After the anæsthetic is finished oxygen is administered If possible the patient s bed is brought to the operating theatre, and he is moved directly from the operating table to his bed on which are warmed blankets

Intramuscular injections of penicillin, which were started before the operation are continued for several days afterwards Penicillin

solution (250 000 units) may be injected into the pleural cavity at the end of the operation and this may be repeated daily for the first week

The drainage tube which was clamped is connected to a sterile under water seal (Fig 232) and care is taken that no air is sucked into the pleural cavity

After operations on the lung it is most important that the patient is frequently encouraged to cough up any bronchial secretions otherwise the bronchi will become blocked, partial collapse of the remaining lobes will occur and this will be followed by pneumonia By moving him on to his side or back at intervals during the first few days expectoration of these secretions will be helped After the first few days he should be kept over towards the affected side so that, should a fistula develop there will be less chance of fluid being aspirated from the pleura into the remaining lung tissue

Respiratory exercises are commenced under the guidance of a physiotherapist whilst the patient is still in bed and are continued for several weeks

Complications These are also referred to above in the general discussion of operations on the thorax

PNEUMOTHORAX This may be due to the leakage of air from a bronchopleural fistula or it may be from the cut surface of a lung following a segmental resection After the latter operation the drainage tube is usually removed from the chest as early as twenty four hours so that leakage of air from the cut surface of the lung will not be encouraged by the suction

BRONCHOPLEURAL FISTULA If the bronchial stump does not heal satisfactorily after lobectomy or pneumonectomy, air will leak into the pleural cavity and the lung will collapse Also any fluid in the pleural cavity will be aspirated into the bronchial tree In many cases the development of such a fistula is indicated by the presence of blood stained sputum This must therefore be taken as a danger signal and the patient placed immediately on the side of the operation If much fluid enters the fistula the other lung will be flooded. In order to avoid such dire results drainage of the chest is indicated as soon as possible In some cases the fistula will heal spontaneously but in others a further operation will be required

CEREBRAL ABSCESS and PERICARDITIS These two complications are especially likely following operations on lungs which contain pus

THORACOPLASTY

Thoracoplasty is an operation in which part of two or more adjacent ribs is resected in order to allow the chest wall to fall in and obliterate a persistent pleural space or a cavity in the lung

An increasing number of localized chronic tuberculous lesions of the lungs are responding to chemotherapy or are being treated by

local resection, but thoracoplasty still has a small place in the management of the cavernous types of lesion which has not been controlled by rest, chemotherapy, etc

With the more extensive types of thoracoplasty, shock may be severe The extent of the operation is therefore guided partly by the patient s response to the operative trauma, and if he is becoming very shocked the rest of the operation is deferred

At the conclusion of the operation the chest flap is placed in apposition with the lung and fixed in position by means of gauze pads If it is not completely obliterated, the upper and lower parts of the cavity may be drained by rubber drainage tubes

The operation is usually carried out in stages to allow the chest wall to become sufficiently fixed so that *paradoxical respiration* of that side of the chest does not occur

If a large area of the chest wall is able to move freely, it will move in the opposite direction to normal when the patient breathes that is, it will be drawn in during inspiration and it will be forced out during expiration If any such paradoxical movement does occur it should be controlled by a pad and firm strapping In addition to interfering with the exchange of gases in the lung paradoxical movement may cause the spread of infection in the same or in the opposite lung

Complications of Thoracoplasty

PARADOXICAL MOVEMENT

ATELECTASIS

CHYLOUS EFFUSION A collection of lymph may follow injury to the thoracic duct

INFECTION OF THE WOUND

OPERATIONS ON THE HEART

Cardiac surgery is concerned with the relief of obstruction (at or near one of the valves) and with the closure of fistulæ (patent ductus arteriosus and septal defects) The operations for the correction of these lesions should be performed before the muscles of the ventricles become tired and chronic heart failure develops and before sclerosis occurs in the pulmonary vessels

CARDIAC CATHETERIZATION

Cardiac catheterization may be performed as an aid to diagnosis

The patient is given an injection of penicillin 500 000 units on the day the procedure is performed and also on the following day

In adults cardiac catheterization is performed under sedation such as pentobarbitone, gr iii, and local anæsthesia but in children general anæsthesia is required

The left arm is prepared as for a major operation

The patient is taken to the X ray screening room and, after the veins at the left elbow are exposed a woven nylon catheter (100 to

125 cm long) is passed up the vein and into the heart Thus, it is possible to measure the pressure and the oxygen content of the blood in the chambers of the heart

Prior to its being introduced, the sterile catheter is washed on the outside and is syringed through with heparinized saline

Whilst the catheter is being inserted a swab, moistened with saline, is held on the wound and heparinized saline is injected along the catheter

The complications of cardiac catheterization are thrombosis and thrombophlebitis of the vein in the arm, irregularity of the heart when the catheter reaches it, and reactions like rigors and similar to those seen with blood transfusions, and they are, in fact, due to the same cause, *i e* inefficient cleaning and removal of old blood clot from the tubing or catheter before it is sterilized

Cardiac catheterization is especially important when operations for atrial and ventricular septal defects and for pulmonary stenosis are being considered

Anæsthesia for Operations on the Heart For some operations, such as the repair of a defect in the ventricular septum, it is necessary to obtain access to the interior of the bloodless heart This is possible by the use of an *extra corporeal circulation through a heart lung by pass* This apparatus pumps the blood from the superior and inferior vena cavæ through a machine which artificially oxygenates the blood and thence back into the aorta If only a shorter period of access to the interior of the heart is required, this is possible with the use of *hypothermia* Under general anæsthesia the body is cooled to not less than 83° Fahr (28 5 C) and then the vessels entering and leaving the heart may be clamped off for up to eight minutes without damage to the vital structures of the body Some surgeons such as Brock prefer to limit cooling to 86° Fahr (30° C)

At the end of these operations on the empty heart the open chambers are filled with saline before the heart is closed and the circulation again permitted through it If this is not done, fatal air embolism will occur

After hypothermia fluids should be limited because of the possibility of causing pulmonary œdema Also the body temperature should be recorded at frequent intervals and a continued rise should be reported This rising temperature indicates that some damage to the brain has occurred during the temporary cessation of the circulation

For operations on the pericardium and for some operations on the heart access to the interior of the bloodless heart is not necessary, and in such cases the conventional methods of anæsthesia may be used

During operations on the heart and great vessels continuous electro cardiographic (E C G) readings of the heart s action are taken

Preparation If digitalis is not already being given this is started a few

days beforehand in order to lessen any tachycardia due to the operation

If a bacterial endocarditis is present in the heart or in relationship to a patent ductus arteriosis or other lesion, prolonged chemotherapy is necessary before operation

In general, however, the preparation for operations on the heart is similar to that described above in the discussion of operations on the thorax

Special Complications of Operations on the Heart

EMBOLISM This may occur during or after operation due to the freeing of a clot from an auricular appendage

AURICULAR FIBRILLATION

CARDIAC ARREST

LARYNGEAL STRIDOR If the left recurrent laryngeal nerve is bruised or otherwise injured post operative laryngeal stridor will occur

DRAINAGE OF THE PERICARDIUM

Serous fluid or pus may be aspirated from the pericardial cavity but as with an empyema thoracis drainage is required when the pus is too thick to pass along a needle

PERICARDECTOMY

In constrictive pericarditis the pericardium on the surface of the heart becomes fibrous and partly calcified This greatly interferes with filling and emptying of the heart blood accumulates in the veins, pleural and peritoneal effusions develop and unless the condition is relieved by the removal of the constricting pericardium the patient eventually dies from heart failure

Preparation If the condition has followed tuberculosis the appropriate antibiotics and drugs will be given before and after operation

Because of the fluid retention, a diuretic should be given before operation and pleural and peritoneal effusions will require aspiration

Position It may be necessary to keep the patient sitting up before during and after the operation in order to keep the pressure in the veins as low as possible

After-Care Apart from the breathing exercises absolute rest should be enforced for some days

Oxygen will probably be required

Even the operation may not completely relieve the greatly increased venous pressure and any blood transfusion must be given very slowly Similarly intravenous infusions if used at all must be given very slowly

If tachycardia or auricular fibrillation occur it may be necessary to increase the dose of digitalis

PATENT DUCTUS ARTERIOSUS

The ductus arteriosus is a communication in the embryo which diverts most of the blood from the pulmonary artery into the aorta so

that very little reaches the lungs After the child is born and the lungs are used for breathing the ductus arteriosus should close If it remains open, the blood from the pulmonary artery and the aorta will be mixed

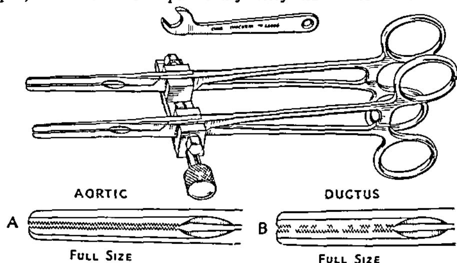


FIG 234 Potts aortic coarcta on and ductus clamps

At operation the patent ductus arteriosus is divided and the ends oversewn The results of this operation are usually very satisfactory for the general condition improves the rate of growth increases and the pulmonary artery and heart decrease in size

MITRAL VALVULOTOMY

Mitral stenosis (narrowing of the mitral valve) often follows rheumatic fever and leads to cardiac failure subacute bacterial endo carditis, and embolism The latter is due to clots forming in the relatively stagnant blood in the left auricular appendage

If such complications have developed or even are only beginning to develop, operation should be considered whenever there is no other associated lesion of the heart

Operation for the relief of mitral stenosis consists of the division of the narrowed valve with a special knife, such as Dogliotti s, which is introduced through the left auricular appendage

The results of closed valvulotomy for mitral stenosis are very good and open operation is not required

COARCTATION OF THE AORTA

The constricted portion of the aorta is usually near the attachment of the ductus arteriosus whether obliterated or not and it causes an increase in the blood pressure to the upper part of the body and a decrease in the blood pressure to the lower part The operative treatment of coarctation of the aorta consists of excision of the narrow portion followed by direct anastomosis of the two ends or their union by means of a prosthesis or graft



FIG 235 The blade of Crafoord s coarctation clamp

TETRALOGY OF FALLOT

The congenital condition which has been named the tetralogy of Fallot consists of congenital pulmonary stenosis a defect of the interventricular septum right ventricular hypertrophy, and displacement of the aorta so that it takes its origin from both the right and the left ventricles

The aim of the operations for the relief of this condition is to make an artificial ductus through which more of the systemic blood may pass into the pulmonary arteries and thence into the lungs

The Blalock-Taussig operation consists of an anastomosis between a subclavian artery and a pulmonary artery whereas in the Potts operation an anastomosis is made between the aorta and the left pulmonary artery

These operations result in considerable improvement in the condition of the blue baby but they may possibly be followed later by the development of infection at the site of the artificial ductus Also, with Blalock s operation, there may be some impairment of the circulation to the hand on the side on which the operation is performed

CONGENITAL PULMONARY STENOSIS

By means of a special punch or knife (Brock s) the narrowed diaphragm like pulmonary valve may be divided and two valve flaps formed This manœuvre overcomes the obstruction and the re fashioning of the valve flap reduces the degree of post operative regurgitation

AORTIC GRAFT

After excision of an aortic aneurysm the defect in the aorta may be repaired with an aortic graft taken under sterile precautions from the body of an otherwise healthy person who has died from the result of an accident Because of the problems of obtaining such grafts it is more likely that a prosthesis will be used This is made with a sewing machine from a piece of nylon or similar material As mentioned above at operation for coarctation of the aorta such a prosthesis may be inserted when it is not possible to bring the ends of the aorta together

CHAPTER 23

ABDOMINAL OPERATIONS

Definition of Laparotomy Laparotomy is defined as an operation in which the peritoneal cavity is opened through the abdominal wall

The treatment after abdominal operations varies widely and we will here limit ourselves to the general preparation and after treatment, and will later describe the special treatment for operations on the stomach intestines biliary passages, etc

Preparation for Operation This does not differ in detail from that previously described in Chapter 8 The external genitals are shaved and the skin on the front of the abdomen from the nipples to the pubes is purified special attention being paid to the umbilicus and the folds of the groins Many patients in whom a laparotomy or other operation is necessary are in poor condition In such circumstances every attempt should be made to improve the general condition prior to operation

On no account should pre operative starvation and purgation be overdone as the patient tends to become dehydrated and thereby more susceptible to shock and acidosis Easily digestible solids may be given up to seven or eight hours before, and fluids to within four hours of the operation unless there is a lesion delaying the emptying of the stomach

If a pre operative aperient is ordered, a mild one such as a small dose of cascara sagrada may be used

Position during Operation The patient is placed on the back and the table is arranged so that it may be readily changed to the Trendelenburg position without disturbing the field of operation

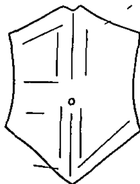


Fig 236 The sites of abdominal incisions

On the right from above downwards these are a Kocker s a right upper paramedian a transverse a McBurney s a right lower paramedian and an inguinal incision In the middle of the diagram there are an upper midline and a lower midline incision On the left of the incisions from above downwards are a thoraco abdominal (broken line) a left upper paramedian a left lower paramedian and a left lower oblique incision

After treatment of Laparotomy In all abdominal operations the result depends to a great extent on the way in which the after treatment is carried out

Meddlesome interference must be avoided but on the other hand

when complications arise treatment should not be delayed Otherwise, there may be great difficulty in controlling them

POSITION Until the effect of the anæsthetic passes away the patient lies quite flat or at the most has only one small pillow, later he is propped up with pillows

If a spinal anæsthetic has been given, he will be kept flat with a very low pillow for the first twenty four hours, otherwise a severe headache, due to the low pressure of the cerebro spinal fluid, is likely

If the patient complains of backache, it will probably be due to an uncomfortable position on the operation table or in bed

DIET Diet is most important The food should be non irritant and easily digestible This is especially important when there is any lesion in the alimentary tract The diet after operation should require little digestion and should not greatly stimulate peristalsis It should have an adequate caloric value with sufficient proteins carbohydrates and fats minerals and vitamins It should be tastily prepared and it should be pleasant in its appearance

In the early post operative period peptonized milk, barley water and Benger's Food may be given

After the first twenty four hours semi solids, such as custard, jelly junket ice cream and bread and milk (without crusts), may be added but solid food is generally delayed until about the fifth day A few grapes or orange juice may be given from the first and as a rule are appreciated

Beef tea which was formerly so popular in invalid diets contains only a trace of protein

NAUSEA This may be due to an anæsthetic agent such as ether but no matter what the type of anæsthesia nausea may follow an abdominal operation for it is partly due to reflex interference with the processes of digestion and with peristaltic activity It may also be caused by certain opiates such as morphine hydrochloride

For the prophylaxis of nausea and for its treatment once it has developed Largactil (chlorpromazine) 25 to 50 mg or Dramamine 50 mg may be given In addition the administration of a draught of sodium bicarbonate will sometimes give relief If this fails the stomach should be washed out

THIRST This is a very distressing symptom and unless there is some definite contra indication the patient should be allowed to quench his thirst with suitable fluids but the quantity taken at one time should not exceed ℥iv If the thirst and the dehydration cannot be overcome by the amount of fluids permitted by mouth intravenous infusion will be required The thirst may also be alleviated if the mouth is kept clean A flow of saliva may be stimulated by sucking small slices of lemon

Sucking ice helps to keep the mouth moist but gives little real relief from thirst

PAIN The pain may be lessened by flexing the patient s knees so as to relax the abdominal muscles, and by injections of morphia or of pethidine

FLATULENCE Flatulence is, as a rule, the chief trouble met with after abdominal operations The distension is soft and uniform For its relief a rectal tube with a wide lumen may be passed twice in the twenty four hours and on each occasion left *in situ* for one hour There are various patterns of rectal tubes but by far the best is the soft indiarubber one with the hole at the end and not at the side like a catheter The end of the tube is well lubricated, and the tube carefully passed into the bowel as it very easily becomes kinked

It is found that the distance a rectal tube can be passed varies greatly in different individuals, but under no circumstances should any force be used to insert it A rectal tube causes very little dis comfort and the relief to the patient is often very marked

Injections of pituitary extract, physostigmine and Prostigmine are somewhat uncertain remedies for flatulence

APERIENTS These are not required as a routine Usually the bowels act after a few days without any outside stimulation How ever if an aperient is given the aim must be to produce a natural action without the production of violent peristalsis This may often be obtained with less upset by the use of enemata or suppositories

Of the aperient drugs small doses of magnesium sulphate (Epsom Salts) or of cascara sagrada are only mildly irritating to the intestines, but even these are liable in some cases to cause vomiting which may be very undesirable

To perform a rectal washout a rectal tube is passed gently and a glass funnel is fitted to the free end Four ounces of warm water is poured into the funnel which is held as high as possible The fluid is allowed to remain in the rectum for a few minutes, after which the funnel is lowered into a basin of water and the solution allowed to run out with a consequent aspiration of flatus from the intestine This is repeated until the two pints are used up, and as a rule this is very successful

URINE The urine secreted is always diminished after an abdominal operation but over a pint should be passed in the first twenty four hours The patient usually passes his urine naturally some hours after the operation but if there be any difficulty in passing it a hot fomentation to the lower abdomen may be found helpful

If no urine is passed by the end of ten hours or if the patient is complaining of discomfort in the bladder an injection of 1 ml of carbachol may be given If this produces no result a catheter should be passed As usual strict aseptic precautions are necessary for this manœuvre

If it is necessary to use the catheter repeatedly sulphacetamide

(1 gramme t d s) should be prescribed as a prophylactic measure against cystitis

THE DRESSING After an abdominal operation no change of dressing will, as a rule be required until the stitches are taken out on the fifth to the twelfth day Occasionally it is advisable to strap the wound with adhesive plaster after the stitches are removed

When drainage has been employed the tube will, with few exceptions such as a T tube in the common bile duct, be removed within forty-eight hours

CONVALESCENCE The time during which the patient must be kept in bed varies greatly not only with different operations, but also with the same operation in different patients It may be emphasized that no repair of tissue is enhanced by mobility and that immobilization of parts subjected to trauma is an adjunct to repair This is especially important after operative repair of a hernia

However, as a prophylactic measure against the development of pulmonary embolism and venous thrombosis, it is necessary for the patient to move about in bed, to exercise his or her limbs from the time of the operation and to thoroughly aerate the lungs at intervals This is often referred to as the ' stir up regime "

ABDOMINAL SUPPORT At the end of the operation the dressing is usually fixed in place with adhesive plaster, but in order not to impede respiration this should be arranged so that it does not surround the abdomen or lower part of the chest Vertically arranged pieces of adhesive plaster are preferable to horizontal in the upper abdomen The chief function of the plaster is to hold the dressing in place rather than to support the abdomen It is only in patients in whom the abdominal muscles are very weak that support other than that of the sutures is required after operation In such patients and in those in whom primary union has not been obtained some form of abdominal support should be worn for some months and in addition exercises of the abdominal muscles should be practised

The support should be elastic and accurately fitting, and the patient should apply it whilst lying down

GENERAL ROUTINE

Operation (2 p m)

FIRST DAY

3 p m After Operation Head low, keep warm, watch breathing, have cradle to keep off weight of the bed clothes if required Deep breathing and movements of limbs hourly

Note when consciousness regained and if vomiting

Morphia or pethidine as indicated usually as soon as conscious

6 p m Temp , Pulse and Resp Prop up if not shocked Deep breathing

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If it is necessary to use the catheter repeatedly sulphacetamide

THIRD DAY

Temp , Pulse, Resp every four hours
Wash patient at 8 a m and 7 p m
Diet—milk, custard egg drinks, mutton broth jelly, bread and milk and ice cream
To get up if no contraindication

FOURTH DAY

Temp , Pulse, Resp every four hours
Diet—as above plus Bread and Butter, and Eggs

FIFTH TO SEVENTH DAY

Temp , Pulse, Resp twice daily and thereafter
Diet—As above plus minced chicken or boiled fish
Enema—may be ordered by some surgeons

EIGHTH DAY

Wound dressed and sutures removed

The fluids referred to throughout this scheme are peptonized milk Benger s food barley water, albumen water milk tea water, fruit juices, flavoured skim milk, etc

COMPLICATIONS OF ABDOMINAL OPERATIONS

Peritonitis Infection of the peritoneum with micro organisms from the surgeon s hands the instruments or the patient s skin etc will be practically abolished by modern surgical technique Occasionally however when the intestines are opened the peritoneum become infected

The two most constant symptoms are increasing distension of the abdomen and increasing frequency of the pulse Owing to the paralysis of the intestine set up by the inflammation the abdomen becomes more and more distended even if strong purgatives and enemata are used In addition to increasing in frequency the pulse becomes progressively smaller in volume

As a rule the patient looks anxious has a drawn expression and lies on his back with his knees drawn up In the early stages the temperature may be raised but in the late stages it may become normal or subnormal and the extremities may grow cold and clammy

At first pain may be present but as the bacterial poisoning deepens the pain disappears and the patient may state that he feels better Vomiting usually occurs at some stage and without treatment it is sometimes almost continuous mouthfuls of foul smelling material perhaps stained black by digested blood being regurgitated every few minutes

TREATMENT In the treatment of post operative peritonitis two different lines of action have been advocated In former times every

10 p m Temp , Pulse, and Resp Morphia or pethidine as indicated, *but not within four hours of previous dose* Mouth cleansed Deep breathing ℥i to drink (unless bowel anastomosis)

FIRST NIGHT

2 a m Temp Pulse, Resp If patient awake, ℥i–ii to drink Morphia or pethidine if indicated

6 a m Temp , Pulse, Resp Mouth cleaned Carbachol if neces sary ℥ii to drink

7 a m ℥ii to drink Wash face and hands Rub back Catheter passed if necessary

8 a m ℥ii to drink, and repeat hourly

10 a m Temp Pulse Resp Clean mouth Morphia or pethidine if indicated

11 a m Add up the time of sleep the patient has had the amount of nourishment and fluids taken, the quantity of any vomitus, and the quantity of urine passed, and enter these data in the report If the patient is able to pass urine naturally and of sufficient quantity omit catheter if not pass catheter thrice daily

SECOND DAY

12 m d ℥ii to drink Wash face and hands Rub back

1 p m ℥ii to drink

2 p m Temp Pulse Resp Mouth cleaned Rectal tube if necessary ℥iii to drink and repeat as required

4 p m Custard ℥ii

5 p m Jelly ℥ii

6 p m Temp Pulse Resp Mouth cleaned

7 p m Wash face and hands back and shoulders rub in zinc cream or Eau de Cologne and powder and continue night and morning Bread and milk ℥ii

9 p m ℥v of jelly and ice cream

10 p m Temp Pulse Resp Mouth cleaned Rectal tube if necessary Sedative or analgesic if ordered

11 p m Add up the amounts of nourishment sleep fluids taken, urine, etc as before

SECOND NIGHT

2 a m Temp Pulse Resp

6 a m Temp , Pulse Resp ℥iv to drink and repeated when required

8 a m Wash patient Bread and milk ℥vi

10 a m Temp Pulse Resp Jelly ℥iv

11 a m Add up amount of nourishment sleep fluids taken, urine, etc

removed The aspirated fluid is measured and charted If the aspiration is carried out efficiently, there will be no material to vomit

The suction may be obtained from an electric pump or from a continuous suction apparatus such as that of Wangensteen Alternatively the nurse can draw off the fluid every quarter or half hour with a syringe

Wangensteen s apparatus consists of three bottles with rubber stoppers, a few feet of rubber tubing, two adjustable clamps and some

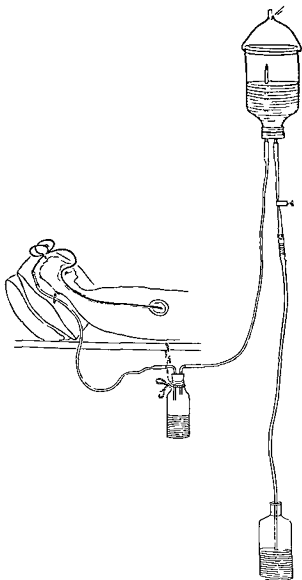


FIG 238 Wangensteen apparatus for applying continuous suction
Sometimes the bottle on the side of the bed is not included but then the material aspirated from the stomach will collect above the cork in the upper bottle and will eventually block the outlet from this bottle

attempt was made to secure free action of the bowels free purgation being looked upon as the only possible means of saving the patient s life

By modern methods the opposite state—absolute alimentary rest—*is aimed at* *No food being given by mouth* *peristalsis is checked* by adequate doses of morphia or of pethidine, by keeping the stomach empty by aspiration and by giving antibiotics Fluids and electrolytes are given intravenously

Considerable evidence has been brought forward to show that, in the early stages of peritonitis, cessation of peristalsis is largely a purposive inhibition and that aperients, which act as local irritants, increase the outpouring of fluid into the bowel

Treatment is along the following lines —

Position *The patient is propped up in the semi sitting or* Fowler s position to facilitate respiration and favour the gravitation of any peritoneal exudate into the pelvis

Sedation The amount of morphia or pethidine given should not be sufficient to depress respiration as these patients are very prone to develop pneumonia Rest for the bowel is obtained by keeping it as empty as possible

Fluids As the muscle of the bowel wall is paralysed by the toxins from infecting organisms fluids swallowed tend to accumulate in the *stomach and are not absorbed* *The need for fluids is greater in these* patients than in normal patients after operation for they are losing large amounts of fluid by exudation into the peritoneal cavity and into the lumen of the bowel Thus replacement by intravenous injection is essential A record of the intake and loss of fluids is kept

Aspiration By means of a small tube passed into the stomach *e g* a Ryle s or Levin s tube as much as possible of the stagnant *fluid and gas in the stomach and the upper portion of the bowel is*

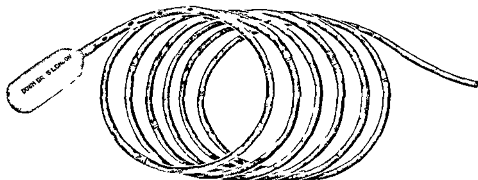


FIG 237 Cantor s rubber tube which is 10 feet long On the end there is a balloon containing mercury

This tube may be used instead of other tubes (Figs 28 and 160) when aspiration of the small bowel is thought to be necessary

removed The aspirated fluid is measured and charted If the aspiration is carried out efficiently, there will be no material to vomit

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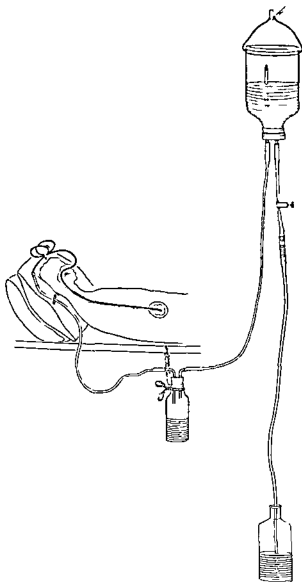


FIG 238 Wangensteen apparatus for applying continuous suction Sometimes the bottle on the side of the bed is not included but then the material aspirated from the stomach will collect above the cork in the upper bottle and will eventually block the outlet from this bottle

water The amount of negative pressure can be controlled by raising the lower bottle or by reducing the flow of water from the upper to the lower bottle by tightening the clamp However, the lower bottle must not be raised above the level of the patient lest the fluid is siphoned back into the stomach

Sometimes the bottle on the side of the bed is not included, but then the material aspirated from the stomach will collect above the cork in the upper bottle and will eventually block the outlet from this bottle

Diet Food has little chance of being absorbed but the patient should be allowed to drink water and other fluids which will not block the tube This is most beneficial for the mouth is kept moist the possibility of parotitis is lessened and the material in the lumen of the stomach is diluted and thus more easily aspirated Milk and unstrained orange juice are to be avoided since they may block the tube

Dextrose, amino acids, and perhaps plasma are included in the intravenous fluids but it is not usually possible to inject the total daily caloric and other requirements If the patient is going to recover it will only be a few days before he is again able to take food by mouth and he will then overcome the slight starvation he has suffered

Salt and Other Electrolytes As the material aspirated from the stomach and the bowel has a high content of electrolytes it may be necessary to replace them in the intravenous fluids

Bowels Aperients and enemata aggravate the abdominal distension and general distress and should be avoided

Drainage If a localized collection of pus develops this should be drained If the pus collects under the diaphragm it is referred to as a subphrenic abscess but if it collects in the pelvis it is a pelvic abscess

Chemotherapy Penicillin sulphonamides and streptomycin are secreted into the peritoneal fluid and may be of great value in the treatment of this condition

The oral administration of succinyl sulphathiazole (sulfasuxidine) or phthalyl sulphathiazole (sulfathalidine) in doses of 6 to 10 grammes daily or of streptomycin orally in doses of 1 0 gramme daily for four days reduces the bacterial content of the bowel and are employed when it is intended to open the bowel at the time of the operation

Ileostomy Formerly in cases of peritonitis and paralytic ileus, an attempt was made to assist the emptying of the bowel by inserting a tube directly into the ileum In most cases unfortunately this tube only drained the loop of the bowel into which it was inserted This type of ileostomy has now been replaced by aspiration of the stomach and upper bowel

Spinal Anæsthesia A spinal anæsthetic is one of the most effective methods of producing contraction of the bowel if such is still possible but in the presence of peritonitis this is rarely justified Any lowering

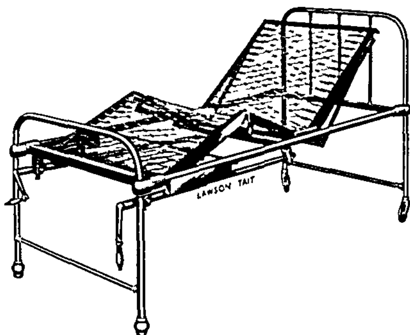


FIG 239 Adjustable bedstead with screw mechanisms which may be operated from the foot of the bed

of the blood pressure associated with the spinal anæsthetic adds to the shock of the patient and vigorous peristalsis may spread the infection throughout the peritoneal cavity

Blood Transfusion If the patient suffering from peritonitis shows signs of shock or of anæmia blood transfusion is indicated

If the patient is going to recover the distension lessens flatus and fæces are passed the amount of fluid in the stomach and bowel diminishes and the pulse becomes slower and fuller Before withdrawing the tube from the stomach a half pint of barley water coloured with cochineal or indigo carmine may be given to drink If in an hour and a half none of the coloured fluid can be aspirated it is proof that the stomach has regained its tone (gastric motility test)

Paralytic Ileus Paralytic ileus is usually due to peritonitis but following an abdominal operation it may be due to a temporary nervous inhibition of the muscle of the small intestine or it may be the result of over stretching and circulatory disturbances of the intestinal muscle

Apart from distension, the most noticeable changes in the affected loops of bowel are a cyanotic tinge vascular engorgement and œdema In addition to a complete or almost complete absence of intestinal movement certain other activities of the small intestine are disturbed in

paralytic ileus, namely the absorption and excretion of fluids and gases

Abdominal distension occurs and in a few hours the patient becomes restless and uncomfortable The pulse rate rises and, unless treated vomiting begins, at first odourless, then brownish and sour smelling

Paralytic ileus is especially likely after an aperient is given

Treatment should consist of aspiration intravenous infusions, etc as described above for the treatment of peritonitis

Acute Dilatation of the Stomach Like paralytic ileus this accompanies generalized peritonitis but it may also occur independently It may develop in conditions in which the abdomen is not opened *e g* after the application of a spinal plaster jacket and after parturition or it may develop twenty four to seventy two hours after an abdominal operation

Without treatment the stomach becomes enormously distended with gas and a thin dark green or brown fluid, the distension may be so great that the abdomen grows tense and tender, and dyspnœa may occur owing to the embarrassed action of the diaphragm

Formerly such a patient was treated by rolling over onto the face and elevating the foot of the bed This was to help the removal of the fluid from the stomach, but if a tube is passed into the stomach and the fluid removed as it accumulates the patient may be nursed propped up

The passage of a tube into the stomach of one of these patients is followed by the escape of a large volume of gas and fluid If a tube is not passed and the fluid allowed to accumulate in the stomach effortless vomiting will soon occur

Early diagnosis is most important hence in all cases of post operative abdominal discomfort accompanied by a rising pulse rate acute dilatation of the stomach should be suspected and treatment instituted Early emptying of the stomach by aspiration with adequate intravenous administration of fluid and salt to replace that lost will usually check the condition

Intestinal Obstruction Mechanical obstruction of the bowel after operation is usually due to the formation of adhesions and kinking of the bowel In contradistinction to paralytic ileus the muscle of the bowel wall is contracting actively above the obstruction and thus the patient complains of colicky abdominal pains and of borborygmi Little or no fæces or flatus is passed and the abdomen becomes distended Without treatment vomiting eventually occurs and the patient becomes ill and dehydrated

If such a patient has been allowed to become dehydrated and shocked these conditions are overcome by appropriate therapy and then the cause of the obstruction is removed at operation



FIG 240 Diagrams showing (1) the bowel obstructed by an adhesion and (2) after division of the adhesion

At (A) thrombosis may occur in the blood vessels and at (B) the bowel may be permanently damaged by pressure of the adhesion and the interference with the blood supply

Parotitis Parotitis, or inflammation of the parotid gland, occurs after various operations but especially when fluids are not taken by mouth The usual cause is infection spreading from the mouth to the parotid glands by way of the ducts (Stenson s ducts) but in rare instances it may be part of a generalized pyæmia

The chief symptoms are toxæmia and pain on movement of the jaw

In the early stages the local application of heat, chemotherapy and perhaps radiotherapy yield satisfactory results but if an abscess forms incision will be required

The free intake of fluids is essential Chewing gum and lime or lemon lozenges are helpful in stimulating a flow of saliva

Prophylactic measures include adequate oral hygiene before and immediately after operation Careful cleansing of the mouth keeping the mouth as moist as possible and postponing elective operations in the presence of bad teeth and infected gums are all important

Hiccough Hiccough is a common complication and there are many drugs and methods which have a reputation for relieving post-operative hiccough Although no method always lives up to its reputation the following are worth trying —

Ten minims of a saturated solution of menthol in rectified spirit freely diluted with water This is repeated hourly if necessary

Ten minims of liquor adrenalinæ hydrochloridi in a teaspoon of water hourly

The administration of a tablet of benzedrine sulphate (one tenth milligram) every eight hours for twenty four hours or until relief is obtained

The hypodermic or intravenous injection of 50 to 100 milligrams of pethidine hydrochloride every two to four hours until the hiccoughs cease Usually one or two such injections are sufficient

The inhalation of eight or ten breaths of carbon dioxide gas

In addition to the administration of drugs the lower part of the thorax may be encircled with adhesive strapping, tightly applied, so as to limit the excursions of the diaphragm

Gastric lavage through a Ryle s tube is occasionally effective

It is in fact, only rarely that all the above measures are not effective, but, unless substantial improvement occurs within thirty six hours injection of the left phrenic nerve with 2 per cent procaine solution may have to be considered

Broncho pneumonia Lung complications such as broncho pneumonia bronchitis etc follow abdominal operations more frequently than those in other parts of the body The causes giving rise to these complications are many and varied, but the chief are —

(i) Aspiration of secretions from the mouth and pharynx into the bronchial tubes during anæsthesia

(ii) Interference with normal respiration and expectoration leading to the accumulation of bronchial secretion in the lungs,

(iii) *Chilling of the patient before during and after the operation*

Free respiration is restricted owing to the pain at the site of the operation and the limited movements of the incised abdominal wall The latter are due to the pain and to any tight binders

TREATMENT Suitable prophylactic measures must be taken to obviate chest complications These include attention to the hygiene of the mouth the avoidance of chills before and after operations the avoidance also of tight bandaging and the early adoption of the semi sitting position

Further prophylactic measures are the routine administration of a hypodermic injection of atropine prior to operation and deep breathing exercises and movements starting soon after the end of the operation and continued at intervals thereafter

When lung complications have arisen the treatment is symptomatic and does not vary from that usually employed in the medical wards such as the use of expectorant mixtures steam tents, oxygen and *chemotherapy*

When the signs in the lungs are widespread and accompanied by dyspnœa and cyanosis oxygen should be administered continuously at a rate of flow varying between three and ten litres per minute, so as to counteract anoxæmia If the respirations are shallow the administration of oxygen should be alternated with the administration of carbon dioxide in oxygen (Carbogen) This stimulates the respiratory centre and causes deeper respiratory movements which are calculated to inflate collapsed areas

In an endeavour to prevent leakage the sides of the oxygen tent should be tucked under a square of waterproof sheeting placed under the patient s pillow

In these circumstances the rate of flow for oxygen should not be

less than ten litres per minute for adults, and around th scale for children —

Aged one, two and three years Three litres per minute
Aged four years Four litres per minute
Aged five to ten years Six litres per minute
Aged over ten years Six to ten litres per minute

A 100 cubic feet cylinder of oxygen running at ten litres per minute lasts approximately four and a half hours

In cases of emergency oxygen may be administered through small sized catheters (No 8) attached to an intranasal tube holder

The most constant and reliable site for determining if cyanosis is present is the finger tips especially under the nails and sufficient oxygen should be administered to keep the finger nails pink

Massive Collapse of the Lung Massive collapse of the lung is frequently associated with an inhibition of the cough reflex either by some toxic or reflex stimulus and is especially liable to occur if the bronchial secretion is thick and viscid

The sputum because of its tenacious character and the inability of the patient to expel it leads to occlusion of the lumen of some portion of the bronchial tree with consequent collapse of part of the lung (Apneumatosis or Atelectasis) To compensate for the smaller space occupied by the collapsed lung the chest wall is depressed the heart and mediastinum drawn to the affected side and the diaphragm pulled upwards

The symptoms usually appear quite suddenly some one to four days after operation and are characterized by pain in the chest dyspnœa rapid pulse and possibly cyanosis The temperature normal at first becomes irregular and ranges up to 102° Fahr or 103° Fahr in a few hours After a few days a cough develops and there may be a small amount of mucopurulent sputum

The condition may terminate rapidly by a sudden reinflation or recovery may take two or more weeks

TREATMENT The simple expedient of rolling the patient backwards and forwards on his sound side may result in his coughing up a mass of sputum reinflation of the lung and immediate relief

As a prophylactic measure when respirations are shallow and in cases in which pulmonary collapse has already developed carbon dioxide (10 per cent in oxygen) may be administered every hour for five minutes at a time with the addition of continuous oxygen administration if cyanosis is present To be effective inhalation should commence as early as possible after the onset for after the lapse of thirty six hours the condition is apt to be complicated by the development of broncho pneumonia Bronchoscopic removal of the mucus so that the inflation of the collapsed lobe may occur has much to recommend it

Phlebitis and Thrombosis Phlebitis and thrombosis are fairly common after abdominal operations, especially those connected with the pelvis The veins most frequently affected are the deep veins of the calf the superficial saphenous veins less often

The attack is generally ushered in by a slight elevation of the temperature and pulse rate and by discomfort in the calf This pain is increased by moving the leg or hanging it down Relief may be obtained by elevating it

If the vein is superficial, it is usually hard and tender, and the foot and leg may be œdematous The possibility of detachment of part of the thrombus must never be overlooked A detached thrombus is called an embolus, and if it is carried to the lung it gives rise to the condition of pulmonary embolism

Treatment The treatment of phlebitis is directed towards the prevention of embolism and the relief of symptoms The affected limb should be elevated and wrapped up in cotton wool which is kept in place by a bandage extending from the buttock to the heel If the pain is severe the limb may be painted with belladonna liniment and heat applied, for example in the form of boric fomentations To prevent further thrombosis heparin may be given

Heparin is an anticoagulant which is prepared from the liver It is given intravenously in a sterile solution containing 5 000 units per ml The initial dose is usually 2 to 3 ml and this is repeated every four to six hours The dose is regulated by estimations of the coagulation time as determined by pricking the lobe of an ear with a needle and then allowing blood to run into pieces of capillary glass tubing These are examined every 15 seconds till clotting occurs This time is taken as the coagulation time and normally is two to five minutes

In severe cases of phlebitis four weeks are allowed to elapse before movement of the leg is permitted as there will then be less chance of dislodgement of the clot and of pulmonary embolism

During the period of enforced recumbency the venous circulation should be augmented by raising the foot of the bed so that the return of blood to the heart from the lower limbs and pelvis is assisted by gravity and by the institution of deep breathing exercises combined with massage and movements especially of the lower limbs

On the other hand when the thrombosis is limited to the saphenous veins a firm compression bandage of Elastoplast should be applied from the toes to above the level of the clot with a firm sponge rubber pad at this point to prevent movement of the clot (Dickson Wright) Whenever possible such a patient should be kept fully ambulant

In order to limit the œdematous swelling, an elastic stocking or a well applied crepe bandage should be worn on the affected limb for many months

Pulmonary Embolism Pulmonary embolism may occur following an abdominal or pelvic operation, usually on about the ninth or tenth post operative day The commonest sources of emboli are the great veins of the pelvis and the veins of the calf The chief causes giving rise to this complication are —

1 Venous Stasis The circulation of blood through the great veins of the lower abdomen depends largely upon respiration and especially upon the action of the diaphragm in raising the intra abdominal pressure With an abdominal incision diaphragmatic movements are reduced in order to lessen the pain consequent upon stretching of the suture line and hence venous stasis tends to occur

2 Liberation of Thrombokinase During operation a considerable amount of thrombokinase is released into the blood stream at the actual operation site This reacts with the prothrombin of the blood to form thrombin

The arrival of thrombin in an area of sluggish circulation predisposes to the formation of an intravascular clot or thrombus

Two types of cases of pulmonary embolism may be distinguished according to the size of the embolus —

Massive Embolism, where a large clot occludes one or other pulmonary artery leading to acute dyspnœa cardiac failure and death within any time from a few seconds to a few hours

Pulmonary Infarction, where a smaller clot lodging in one of the pulmonary branches obstructs the blood low to one sector of the lung and is followed by signs of consolidation of that part of the lung The symptoms are less severe, are followed in a few hours by a rise of temperature and later by a cough and blood stained sputum

TREATMENT Breathing exercises frequent movements and changes of posture preservation of the fluid reserve in the body and perhaps the use of digitalis heparin and thyroid extract are indicated as prophylactic measures against venous stasis

If an embolus has passed to the pulmonary artery and the patient has not died immediately morphia is given to relieve the pain oxygen is administered the foot of the bed is raised to improve the circulation to the brain the patient is kept warm and heparin is given to prevent clotting around and beyond the embolus However since treatment in cases of massive embolism is so often futile it is essential to employ all possible methods to reduce the incidence of this complication

An operation for the removal of the embolus from the pulmonary artery has been described by Trendelenburg but it is only rarely that the surgeon has the opportunity to attempt it

In order that this operation of pulmonary artery embolectomy may be successful it is necessary to open the chest and to remove the embolus from the artery within minutes of its lodging there That means having immediately available the necessary surgical equipment

for a thoracotomy plus Trendelenburg s tourniquet and various forceps for dilating the pulmonary artery for removing the clot and for closing the pulmonary artery In addition, it necessitates a good light an efficient sucker and intelligent assistance for the surgeon

Despite these difficulties several successful cases have been reported from hospitals where everything was in readiness

Stitch Suppuration Suppuration around deep stitches is due to the multiplication of organisms which have been implanted with those stitches The infection which may not be obvious until the fourth to the seventh day is usually found to be of a mild type

One or two superficial stitches should be removed and the collection of pus tapped by the insertion of sinus forceps

Post-operative Rupture of the Suture Line Post operative bursting open of the incision may occur in asthenic individuals from septic infection of the wound syphilis or cancerous cachexia It is also associated with vitamin C deficiency and with a deficiency of protein It happens usually between the fourteenth and the twenty first days when even a cough or sneeze may be sufficient cause Sometimes the peritoneum remains intact but at others the entire wound ruptures allowing prolapse of the viscera As a first aid measure sterile towels should be placed over the wound and a firm abdominal binder applied to prevent further escape of the abdominal contents An immediate secondary suture must then be undertaken following which the wound may heal An incisional hernia is to be expected later in many of these cases

As vitamin C deficiency leads to a disorganization of the whole orderly process of wound healing full doses should be given to all elderly patients suffering from gastro intestinal disease for three days or more prior to laparotomy and continued afterwards for some days

Incisional or Ventral Hernia. Stretching of a scar in the muscles and the formation of an incisional hernia may follow any abdominal incision but it most often happens after a wound has suppurated If an operation scar shows any sign of weakness, the patient should be advised to wear a properly fitting abdominal belt

CHAPTER 24

THE BILIARY PASSAGES, APPENDIX, SPLEEN, LIVER AND HERNIÆ

OPERATIONS ON THE BILIARY PASSAGES

THE chief operations performed on the gall bladder and the bile ducts are —

Cholecystotomy, in which the gall bladder is opened and, after its contents have been removed, it is sutured This is an operation open to grave objections and it has now been abandoned

Cholecystostomy, the operation of making an opening into the gall bladder and draining it

Cholecystectomy, which consists in excision of the gall bladder

One of the modifications of cholecystectomy is electro surgical obliteration of the gall bladder in which the upper wall of the viscus

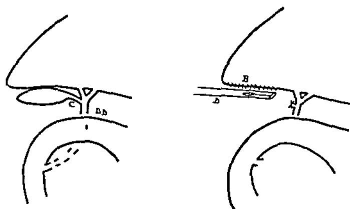


FIG 241 Diagrams to show the normal anatomical arrangement of the gall bladder and the cystic duct (C) which joins the common bile duct (CBD) and then enters the duodenum

During the operation of cholecystectomy the cystic duct is ligated and divided and the gall bladder bed on the liver (B) is oversewn A drain tube (D) is inserted as a safety measure lest there be any drainage of bile

is left attached to its bed in the liver and the lining mucosa is destroyed by electro coagulation

Cholecystenterostomy, which consists in the formation of a permanent opening between the gall bladder and some part of the small intestine It is commonly performed for cases of irremovable obstruction of the common bile duct in order to provide a new opening for the escape of bile into the intestine

for a thoracotomy plus Trendelenburg s tourniquet and various forceps for dilating the pulmonary artery, for removing the clot and for closing the pulmonary artery In addition, it necessitates a good light, an efficient sucker and intelligent assistance for the surgeon

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After-treatment CHOLECYSTECTOMY, CHOLECYSTENTEROSTOMY AND CHOLEDOCHOTOMY The after treatment of these operations does not differ from that already described for abdominal operations in Chapter 23, but whenever the lumen of the biliary passages has been opened drainage of this area of the abdomen is indicated

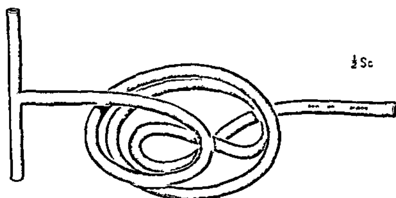


FIG 242 Kehr s rubber T tube This is available in sizes from 8 to 18 English catheter gauge and is 40 inches long

The transverse portion is inserted into the common bile duct and the other end drains into a bottle which is affixed to the side of the patient It is better not to attach the bottle to the bed as the patient may move about and cause *tension on the tube and thus on the common bile duct* Any injury to this structure will have serious consequences

In these operations the peritoneal cavity is drained by a rubber tube brought out either through the abdominal wound or through a separate stab wound This tube should be removed about the second or third day

Position After the patient has regained consciousness he should be placed in the semi sitting position

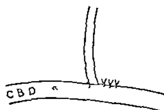


FIG 243 Diagram showing T tube in the common bile duct

Stitches The wound usually heals by primary union the stitches being re moved about the eighth day

Diet The diet is very similar to that advocated for abdominal operations in general but during the re establishment of the natural avenue of the flow of bile fats should be restricted

Bowels After operations on the biliary passages the patient is liable to suffer from tympanites and sluggish bowels and these may require treatment

A specimen of the motions and urine should be kept each day for the surgeon s inspection

CHOLECYSTOSTOMY In this operation a drainage tube is inserted into the gall bladder and brought out either through the abdominal incision or through a separate stab wound and connected by means

Choledochotomy, the operation of opening the common bile duct for the removal of a gall stone after which the duct is sutured and a drain inserted down to the point of closure

Choledochostomy, the operation of exposing opening and draining the common bile duct A Kehr s or Maingot s T tube or a No 12 soft indiarubber Jaques catheter is then inserted into the lumen of the duct

Preparation of the Patient The preparation of the patient does not differ in detail from that already described in Chapter 23 However the functional activity of the liver cells as estimated by various liver function tests such as the galactose tolerance or Quick s hippuric acid test may be reduced and it is advisable for some days preceding the operation to give the patient amino acids such as methionine and as much dextrose as possible

In those cases in which the outflow of bile into the intestine is hindered, jaundice ensues It is characterized by a yellow tingeing of the skin and mucous membranes and the urine becomes a greenish or brownish yellow It is important in these cases that specimens of the urine and fæces are reserved for the surgeon so that he may estimate the degree of obstruction As was stated when discussing hæmorrhage (Chapter 16) chronic jaundice interferes with the normal clotting of the blood and is therefore a marked predisposing cause of post operative hæmorrhage

Prior to operating on deeply jaundiced subjects the prothrombin clotting time should be estimated and the particular blood group to which the patient belongs determined

The pre operative preparation should include either a blood transfusion or the intramuscular injection of 20 mg of methyl naphthoquinone (the chemical analogue of vitamin K) spread over three days to raise the prothrombin index of the blood

It is sometimes advisable to postpone operation in cases of decreasing jaundice for as long as the serum bilirubin continues to fall

In cases with marked liver damage dextrose should be administered intravenously by the continuous drip method for twenty four hours prior to the operation and for the first two or three days afterwards or until the patient is again able to assimilate a high carbohydrate diet

Owing to the exclusion of bile from the alimentary tract chronic jaundice is frequently associated with incomplete digestion and absorption of fats To compensate for this, ox bile (80 grains in cachets) may be administered with each meal for a week or more prior to operation

Position of the Patient at Operation. Some surgeons require a sandbag or back rest under the small of the patient s back at the level of the liver In addition the head of the table may be elevated to the extent of 15° so that the intestines will gravitate towards the pelvis

insufficiency, of which two types may be distinguished, is uncommon but, when it does occur, it is usually noticed about the third to eighth day after operation

Failure of Hepatic Function Without perceptible increase in the jaundice, the bile becomes pale, watery and increased in quantity Progressive weakness occurs, associated with certain nervous phenomena such as restlessness, prostration or delirium, and rapidly proves fatal

Renal Failure Secondary to Hepatic Failure Here rapid increase in the intensity of the jaundice is associated with reduction or cessation of the flow of bile, and a progressive rise in the blood urea occurs Usually the patient has a slow pulse, slight fever and a dry tongue, drowsiness passes into coma, which in turn gives place to death

Post operative Acidosis Hepatic inefficiency may cause a disturbance of the carbohydrate metabolism in which the formation of acids within the body leads to excessive neutralization of bases It is treated by giving dextrose and alkalis The latter may be given as sodium bicarbonate in doses of 30 to 60 grains by mouth as required

Hæmorrhage As explained in Chapter 16 cases of chronic jaundice are liable to suffer from capillary oozing and suitable prophylactic measures should be observed If hæmorrhage occurs, it should be treated by pressure with gauze soaked in adrenalin solution and by blood transfusion Vitamin K will be required to prevent its recurrence

Biliary Fistula Occasionally the opening from which the drainage tube is removed does not close and a permanent fistula which discharges bile results It is usually due to blockage of the common bile duct, *e g* by an impacted gall stone and a second operation will probably be necessary

When a residual stone is located by cholangiography to be in the common bile duct an attempt may be made to break up the calculus by instilling 1 to 5 ml of ether (or ether diluted by alcohol, two to one) into the duct twice or three times a day At the same time a crushed tablet of nitroglycerin should be administered orally thrice daily and 2 drachms or more of a saturated solution of magnesium sulphate should be taken each morning to relax the spasm of the sphincter of Oddi so that any fragments may be expelled into the duodenum However it is most likely that these procedures will fail to dispose of the stone and that its operative removal will be necessary

The skin around a biliary fistula soon becomes excoriated unless care is taken This can be avoided by preventing contact of the biliary secretions with the skin by covering the latter with a thick ointment dressing In those patients in whom there had been a prolonged and excessive drainage of bile it was formerly the custom to refeed them with portion of this bile by means of a stomach tube However the

of a glass junction with a long rubber tube (about equivalent to 26° French) The tube should be securely fixed to the skin or dressings, so that it cannot be accidentally withdrawn

A straight tube has the disadvantage that it is liable to kink, and therefore it is preferable to employ an angular rubber tube or an angular glass tube similar in shape to a colostomy tube

As in the case of other operations on the biliary passages the contiguous area of peritoneum is drained by another tube brought out through either an independent stab wound or through the incision

Cholecystostomy Tube When the patient is put back to bed the end of the rubber tubing connected with the cholecystostomy tube is placed into a suitable receptable fastened to the side of the bed or better still into a bottle secured to the side of the patient by tapes since a long tube leading to a receptacle restricts the patient s movements An open bottle fixed to the patient may be easily spilled Thus the bile should be collected in a four ounce medicine bottle stoppered by an indiarubber teat through which the rubber tubing passes *via* a small lateral slit thereby affording a watertight junction

A small puncture at the apex of the nipple equalizes the atmospheric pressure and the bottle is provided with a sling made of adhesive plaster so that it may be securely fastened to the abdominal binder In this manner the bile collected can be measured and the amount should be recorded every night and morning The above tube is usually removed about the seventh day The inverted serous surfaces of the gall bladder then come into contact and provided the common bile duct and the cystic duct are patent, the opening closes a few days later

Peritoneal Drainage Tube At the end of the third day, if there is no evidence of infection the peritoneal drain may be removed and its track allowed to heal by granulation

CHOLEDOCHOSTOMY As stated previously a Kehr s or Maingot s T tube or a drainage tube about the size of a No 12 Jaques catheter is inserted into the lumen of the common bile duct and the remainder of the opening is closed by interrupted stitches (Figs 242 and 243)

The T tube may be removed if clamping the tube for forty eight hours gives rise to no discomfort However if the patient experiences attacks of pain after the tube is clamped a persistent obstruction in or around the duct must be suspected and a post operative cholangiogram should be undertaken This consists of an X ray examination made after the injection of 10 to 30 ml of radio opaque 50 per cent iodized oil Normally it reveals no obstruction in the vicinity of the ampulla of Vater or elsewhere in the bile ducts

The post operative treatment is in all other respects exactly similar to that following cholecystectomy

Special Complications of Biliary Operations CHOLÆMIA Hepatic

Leakage of Intestinal Contents may occur from the stump of the appendix and give rise to local or general peritonitis, or in rare instances to a fæcal fistula

Adhesions may form in the vicinity of the appendix and later give rise to pain and constipation or even to intestinal obstruction

Pelvic Abscess is only likely after a routine appendicectomy if blood collects in the pelvis after operation If infection occurs, an abscess will then result

Appendicectomy in the presence of Local Peritonitis This is usually performed as an emergency operation in cases of acute appendicitis, and hence there is little time for the preparation of the patient beyond preparing the skin of the abdomen and, if necessary, evacuating the lower bowel by an enema

Where the peritoneum is infected and especially when an abscess is present a drain half an inch in diameter and perhaps containing a thin wick of gauze, is brought out either through the abdominal wound or through a separate stab wound in the abdominal wall

Drainage by gauze is now rarely adopted, having been found un satisfactory because the removal of the gauze is very painful and in addition may be extremely difficult Also, peritonitis has been known to follow its removal, owing to the breaking down of adhesions

AFTER TREATMENT *Position* As with most abdominal operations as soon as the patient has come round from the anæsthetic, he should be propped up in the semi sitting position

Drainage The treatment of the wound is very much the same as that adopted for other abscesses and the main point to be observed is that the drainage tube is shortened daily after the second day Thus the wound has a chance to heal from the bottom upwards

If gauzes have been used for drainage, their removal should be commenced on the third day when they can be removed gradually or *in toto*

Dressing The wound should be dressed daily or more frequently according to the amount of the discharge and the dressing should be continued until the discharge ceases In those cases where there is a large foul abscess cavity irrigation may be instituted after the third day and carried out once or twice daily The best fluid to use is Normal saline but if the abscess cavity is very foul hydrogen peroxide in the strength of five volumes will be found very useful The irrigation must however be gently carried out and free exit allowed for the return flow otherwise some of the fluid may be forced into the peritoneal cavity and give rise to peritonitis

Bowels For some days after operation a certain amount of difficulty may be experienced in getting the bowels to act but enemata and aperients should be avoided as a routine since the bowels will usually act normally once the inflammation has subsided

value of bile in the digestive tract lies in its bile salt content, hence it would appear to be more beneficial to administer bile salts by mouth than to return drainage bile in which the bile salt concentration may be low

Persistence of a mucous fistula after cholecystostomy indicates obstruction of the cystic duct, and for its cure cholecystectomy will often be necessary

ACUTE POST OPERATIVE NECROSIS OF THE LIVER, first described by Heyd, is possibly due to accidental ligation of the hepatic artery It is characterized by sudden, rapid and progressive rise in temperature during the first day after surgical operation, falling blood pressure rapid pulse circulatory collapse coma and death The temperature rises to 107° Fahr or more within thirty six to forty eight hours

Post mortem examination reveals passive congestion, softening and diffuse disorganization of the liver cords with widespread areas of focal necrosis of the liver

LUNG COMPLICATIONS Owing to the interference with respiration caused by the operation and the painful abdominal wound, atelectasis and pneumonia commonly occur after biliary operations and should be guarded against by breathing exercises and by nursing the patient in the semi sitting position

INCISIONAL HERNIA Patients occasionally develop post operative herniæ after biliary operations and in cases where there appears to be weakness of the wound an abdominal support should be worn for some months after the operation

OPERATIONS ON THE APPENDIX

The chief operations performed on the appendix are —

Appendectomy or Appendicectomy which consists in removal of the appendix and

Appendicostomy, which consists in bringing the appendix through the abdominal wall and in removing its tip so that a fistula is formed through which the colon can be irrigated by means of a rubber appendicostomy tube

This operation used to be popular in intractable cases of chronic ulcerative colitis but in them it has now been replaced by ileostomy and colectomy

APPENDICECTOMY

Appendicectomy in the Quiescent Period When appendicectomy is performed in the intervals between acute attacks the so called interval appendix ' the preparation and after treatment do not vary from that already described for laparotomy cases in Chapter 23

SPECIAL COMPLICATIONS *Thrombosis of the Femoral Vein* Thrombosis of a femoral vein is not uncommon it is usually due to mild sepsis and occasionally gives rise to pulmonary embolism

stage of appendicitis proper, and (ii) the perforative peritonitic stage, characterized by local or spreading peritonitis

For cases coming under observation after forty eight hours from the time of onset immediate appendicectomy carries high mortality and morbidity rates, and for such cases the Ochsner Sherren treatment may be used However, this is only possible in a well equipped private or public hospital, and it is quite unsuitable for children, the aged or those cases where a smart purgative has recently been administered Formerly the method consisted of the four Fs" Fowler s position, fluids only, fomentations and four hourly chart but now the antibiotics have been added

Position The patient is placed in Fowler s position

Diet For the first four days or until the temperature becomes normal water, and water only, is given by mouth Supplementary fluids may occasionally be given intravenously

Fomentations Heat may be applied to the abdomen in the form of hot stupes

Chart The temperature is taken four hourly and the pulse hourly, and both are recorded in graphic form on a chart Any vomiting must be noted and recorded, together with particulars as to time amount and character

Drugs Opiates are avoided, and no purgative should be given until resolution is complete Streptomycin and penicillin therapy is usually advisable

Bowels Unless opened naturally the bowels should be left confined until the seventh or eighth day, when a glycerine enema may be administered No aperient should be supplied until the temperature and pulse have been normal for at least a week and then only liquid paraffin in small and repeated doses

Under this treatment the local peritonitis usually resolves, but a rising pulse rate, or pain persisting after the first six hours, indicates spread of infection and that this treatment should be abandoned Laparotomy should be performed immediately

The nurse should be specially instructed to report immediately to the surgeon the occurrence of —

(i) A rising pulse rate, (ii) vomiting (iii) persistence or recurrence of the pain and (iv) the onset of diarrhœa especially if it is accompanied by the passage of mucus

THE SPLEEN

The spleen may be removed (splenectomy)

(1) During the course of an extensive gastrectomy This facilitates the operation and also, in some cases the spleen is involved by a carcinoma of the stomach

(2) After an injury *i e* when the spleen is ruptured and there are signs and symptoms of an increasing internal hæmorrhage

Flatulent Distension Owing to the liability to develop flatulent distension and tympanites a rectal tube may be inserted at intervals

Rest in Bed The patient should be kept in bed until the acute inflammation has subsided

Abdominal Belt In those cases where drainage has been employed and there is weakness of the muscles, the use of a well fitting abdominal belt is advisable

SPECIAL COMPLICATIONS *General Peritonitis* is due to infection of the peritoneum either before, during or after operation It should be treated by the use of antibiotics, the establishment of free drainage the adoption of Fowler s position aspiration of the stomach and the administration of fluids by the intravenous route

Formation of Secondary Abscesses If imperfect drainage has been adopted then in the course of seven to ten days the patient may suffer from a recurrence of the pain in the wound and pyrexia These are due to some pocketing of pus *i e* a collection of pus is shut off from the rest of the wound In other words, a secondary abscess forms in the deeper parts of the wound and will require opening

Infection of the Abdominal Wall This is a fairly common complication but it is usually limited to cases in which a tube has been inserted However in old and fat patients with poor resistance to infection it is often wise to leave a piece of soft rubber drain in the superficial layers of the wound This will decrease the possibility that a cellulitis will develop subsequently

Fæcal Fistula occasionally follows appendicectomy owing to the suppurative process involving the cæcum near the base of the appendix This leads to sloughing and leakage of the bowel contents These fistulæ usually close spontaneously, and the care of the wound does not differ from that already described elsewhere for infected wounds

Adhesions After an abscess has been opened or when there has been much inflammatory reaction round the appendix, adhesions are especially likely to form in this region and as they contract they may press on the bowel and cause discomfort pain or even intestinal obstruction

Incisional Hernia After an operation for suppurative peritonitis in which the wound has been drained, incisional hernia occasionally occurs

Lung Complications Owing to the spread of inflammation right sided pleurisy and empyema occasionally occur after cases of appendicular abscess

Pulmonary embolism is a rare complication but when it does occur it may be directly connected with thrombosis of the femoral or pelvic veins

Ochsner-Sherren (Delayed) Treatment of Acute Appendicitis There are two distinct periods in an attack of acute appendicitis —(i) the

the rupture is therefore referred to as an *inguinal*, *femoral*, or *umbilical* hernia respectively *Incisional* herniæ occur through previous wounds

At first the herniated contents return to the abdomen on lying down, and later may be replaced by manipulation (or taxis) In both of these conditions the hernia is said to be *reducible* Conversely, if the herniated contents cannot be returned to the abdomen by manipulation the hernia is said to be *irreducible*

A reducible hernia can in many instances be kept up by a suitable truss which contains a steel spring

A hernia is said to be *strangulated* when there is interference with the circulation of the contents of the hernial sac This is usually due to pressure on the blood vessels as they pass through the hernial orifice

Operations for Hernia

The chief operations performed on herniæ are —

Herniotomy, which consists of exposing and opening the hernial sac, reducing its contents into the abdominal cavity, and removing the sac

Herniorrhaphy, which combines excision of the hernial sac with repair of the gap in the abdominal wall by means of absorbable or unabsorbable sutures If the muscles are weak, the repair may be reinforced with a patch of tantalum gauze (Koontz)

Hernioplasty which is similar to herniorrhaphy except that repair of the abdominal wall is effected by means of living sutures commonly obtained from the deep fascia of the thigh

Preparation for Operation This, as regards the diet care of the bowels and cleansing of the skin of the operation area is similar to that described for abdominal operations in general

After treatment *Formerly the dressings were kept in place by an* ascending spica of the hip but adhesive strapping is now considered adequate In young children it is advisable to apply some protective over the bandage in order to avoid fouling of the dressing by urine With this object in view a piece of jaconet with a hole cut in it for the penis may be placed over the dressings to keep them dry However the same result may be obtained by painting the wound with a protective such as Mastisol

Position of the Patient In the after treatment of a patient following an operation on a hernia it is important to avoid tension on the wound To further this object the patient should be nursed in the semi recumbent position with the knees slightly flexed in order to relax the abdominal muscles

Diet The diet should be light until the bowels have acted, after which ordinary diet may be administered

Bowels As a rule the bowels are left to act of their own accord

Dressings The wound remains undisturbed till the sixth to eighth day when the stitches are removed and a light dressing applied

(3) In familial acholuric jaundice (familial or congenital hæmolytic jaundice) In these cases the spleen is causing destruction of the abnormal red cells (spherocytes) which are more fragile than normal After splenectomy the red cells remain fragile but their rapid destruction ceases

(4) In essential thrombocytopenia (essential thrombocytopenic purpura) In these cases the number of platelets in the circulating blood is reduced and bleeding occurs After splenectomy the tendency to bleed is greatly reduced

(5) In some cases of Banti s disease and of cirrhosis of the liver In these cases there is some obstruction to the flow of blood through the liver and removal of the spleen reduces the amount of blood passing to the liver

COMPLICATIONS The special complications after splenectomy are —

(a) Shock due to hæmorrhage
(b) Delayed healing of the wound due to injury of the tail of the pancreas
(c) Wound disruption
(d) Incisional hernia
(e) Hiccough due to irritation of the branches of the phrenic nerves on the lower surface of the diaphragm
(f) Pleural effusion
(g) Hæmatemesis due to congestion of the gastric mucosa

THE LIVER

In some cases of cirrhosis of the liver an attempt is made to reduce the portal hypertension (the increased pressure in the portal venous system) by anastomosing the splenic vein (after splenectomy) to the left renal vein (lieno renal anastomosis) or by anastomosing the portal vein to the inferior vena cava (porto caval anastomosis) After these operations there is thus a communication between the systemic and the portal venous systems and the pressure in the latter is reduced At the lower end of the œsophagus there are normally small communications between these two venous systems but in cases of portal hypertension these communications greatly increase in size and sometimes burst As a result hæmatemeses occur The operations of lieno renal and of porta caval anastomosis as mentioned above reduce this pressure and consequently the tendency to bleed is reduced

HERNIÆ

An abdominal hernia or rupture is the protusion of a portion of the abdominal contents either through one of the natural openings for the passage of vessels or nerves or through any part of the abdominal wall which is naturally weak or has been weakened by injury or disease The common sites are the groin top of the thigh and umbilicus and

After treatment The after treatment will be similar to that described for operations on the bowel in Chapters 25 and 26

Special Complications The special complications relate to the damaged loop of bowel rather than to the operation itself

PERITONITIS may occur either from the escape of bacteria through the damaged walls of the intestine or from rupture of a gangrenous loop of bowel

ACUTE ENTERITIS may arise at the site of strangulation and is characterized by localized pain, vomiting and the passage of mucus which may be bloodstained Treatment consists of a fluid diet and the administration of bismuth and opium

FLATULENT DISTENSION OR METEORISM may occur Its treatment is similar to that described under the complications of abdominal operations

STENOSIS OF THE INTESTINE at the site of strangulation may ensue and give rise much later to an intestinal obstruction

REST IN BED According to the wishes of individual surgeons the patient is kept in bed for up to three weeks At the end of a month the patient may return to his normal habits of life provided they are not of a very strenuous nature

Special Complications RETENTION OF URINE Occasionally male patients have difficulty in micturition for the first twenty four hours after operation This is partly due to the position they have to assume, and partly a reluctance to exert the abdominal muscles If the patient turns on his side he is usually able to accomplish the act However, if he fails Carbachol should be given, and if he is still unsuccessful a catheter should be passed

PERSISTENT VOMITING This occasionally occurs after operations for the cure of large herniæ and appears to be due to the increased abdominal pressure caused by the replacement into the abdomen of a large bulk of hernial contents The stomach should be aspirated the diet should consist of fluids only and the bowels should be emptied by an enema

INFLAMMATION OF THE TESTICLE (ORCHITIS) This is not very common It probably arises from interference with the veins of the testicle at the time of operation It is characterized by pain, tenderness and swelling of the testicle on the affected side, and should be treated by the application of evaporating lotions and by supporting the testicle by a pillow or slinging it well up by means of strapping

SEPSIS This is a particularly annoying complication especially as it sometimes results in recurrence of the hernia

RECURRENCE With modern methods of operation recurrence of hernia takes place less often

STRANGULATED HERNIA

In cases of strangulated hernia intestinal obstruction occurs the circulation in the herniated loop of bowel ceases and bacteria pass from the lumen into the intestinal wall and eventually into the hernial sac itself

Strangulated hernia is a condition dangerous to life, for it finally leads to gangrene of the herniated loop of bowel and immediate operation is necessary for its relief

Preparation of the Patient As the operation is usually performed as an emergency there is little time for the preparation of the patient other than preparing the skin of the abdomen and perhaps emptying the lower bowel by an enema If there is any abdominal distension the stomach is washed out and aspirated and the patient is sent to the theatre with a Ryle s or Levin s tube in place

In the majority of cases the gut is still viable, so that strangulation is relieved and operation performed in the usual way but if the gut is found to be gangrenous bowel resection (enterectomy) will have to be performed

around the lower end of the œsophagus for the condition of cardio spasm (achalasia of the œsophagus) The after care is similar to that for other laparatomies

STOMACH

The operations performed on the stomach (Fig 246) are —

Gastrotomy In this operation the stomach is temporarily opened for the purpose of exploring its interior, or for the removal of a foreign body It is then repaired with sutures and returned to the abdomen

Gastrostomy Gastrostomy is most often performed when there is obstruction of the œsophagus An opening is made through the abdominal wall into the stomach, and thus food can be introduced directly into its interior

Total Gastrectomy This is sometimes performed for cancer, the whole of the stomach being removed

Subtotal Gastrectomy This is performed for peptic ulcer and for cancer In this operation a large portion of the stomach is removed

Gastro-enterostomy In this operation an opening is made between the stomach and jejunum to circumvent narrowing of the pylorus

If the anterior surface of the stomach is engaged in the anastomosis the operation is described as an ' anterior gastro enterostomy if the posterior surface is selected, the operation is known as a posterior gastro enterostomy '

Vagotomy Vagotomy is the division of the two vagus nerves and their branches on the junction between the œsophagus and the stomach This abolishes the formation of some of the acid in the stomach It is used by some surgeons in the treatment of peptic ulceration

Pyloroplasty is a plastic operation on a narrowed pylorus in order to increase its lumen It is rarely used nowadays except in combination with vagotomy

Oversewing of a Ruptured Ulcer

GASTROSTOMY

Preparation for Operation This does not differ from that already described for abdominal operations in general

If the patient is very dehydrated glucose and water will be given intravenously If the patient is able to swallow dextrose drinks and peptonised milk drinks may be given up to within four hours of the operation

Gastrostomy is usually performed at a time when the patient s general condition has already suffered much from lack of nourishment and hence suitable precautions must be taken for counteracting shock The gastrostomy opening may be brought out through the original wound or through a separate stab wound

CHAPTER 25

THE ŒSOPHAGUS, STOMACH AND INTESTINES

ŒSOPHAGUS

THE common operations performed on the œsophagus are —

Œsophagoscopy and Removal of a Foreign Body After this procedure there may be no reaction but all cases should be watched for any evidence of spread of infection to the mediastinal tissues around the œsophagus such as a rise in temperature, malaise, and pains in the chest and abdomen If there is any likelihood that perforation of the œsophagus has occurred the saliva should be sucked out continuously and nothing should be given by mouth At the same time penicillin and other antibiotics should be given prophylactically as, once infection of the mediastinal tissues (or mediastinitis) develops it may be rapidly fatal despite all treatment

Œsophagoscopy and the Insertion of a Souttar's Tube This is a spiral tube made of wire which is inserted down an œsophagoscope into the lumen of an irremovable carcinoma of the œsophagus The tube is then left in place and food and fluids pass down through it to the stomach After a time the tube may loosen and pass in the motions Thus every motion should be examined routinely after a Souttar s tube has been inserted



FIG 244 Souttar s flexible spiral wire tube This is available in three sizes 5/16 3/8 and 7/16 of an inch in diameter

After dilatation this tube is inserted through an œsophagoscope into the lumen of an irremovable carcinoma of the œsophagus

Œsophagectomy Removal of the œsophagus is occasionally performed for carcinoma of the œsophagus Most of such patients are in poor condition due to interference with swallowing and often the condition is advanced before the diagnosis is made It is rarely possible to improve the general condition to any extent before operation and therefore it carries a fairly high mortality rate The post operative nursing of these cases will be a combination of that required after gastrectomy and after thoracotomy

Heller's Operation This procedure is usually carried out through the abdomen It consists of the division of the muscle and scar tissue

the gastrostomy tube using an apparatus similar to an intravenous infusion set

The diet recommended by Varco is very satisfactory for gastrostomy feedings This consists of —

6 whole eggs,
2 egg whites,
4 oz skimmed milk powder,
300 Gm sugar, and
1 000 Gm skim milk

This makes up about 1½ litres and contains approximately 2,446 calories If possible, 3 litres should be given per day until the general condition is restored, after which, less will be required This mixture can also be used for pre operative and post operative oral feedings

Vitamin requirements are given as Marmite and as the juice of oranges In cases of gross vitamin deficiencies they are given by injection

As an alternative to the fluids semi solid food may be given through the tube by means of a grease gun

Thirst may be relieved by running a little water into the stomach between the feeds which not only relieves thirst but also prevents blocking of the tube by coagulated milk If sufficient fluid is not tolerated in the early stages, an intravenous infusion should be started

The patient s weight is a useful index of his progress on gastrostomy feedings

The stools should be examined from time to time with a view to determine which articles of diet are being incompletely digested

THE TUBE During the first few days the greatest care must be taken not to displace the tube for at that stage there will be difficulty in re placing it After eight days it is removed daily, cleansed and reinserted

After about a month the tube may be left out at night and the fistula covered with a gauze dressing, otherwise the opening may enlarge from the elastic pressure of the tube If the opening becomes too big, the tube or plug must be left out for twenty four or forty eight hours alternatively, if the opening tends to contract, the tube or a gastrostomy rubber plug must be worn continuously

THE MOUTH The patients suffer severely from dryness of the mouth and inability to taste their food

The former may be alleviated by keeping the mouth clean and moist the latter by allowing the patient to chew a small quantity of food which is expectorated if there is some contra indication to its being swallowed, such as an obstruction of the œsophagus

THE DRESSING The wound should be inspected daily to see if any regurgitation of stomach contents has taken place On the eighth day the stitches are removed and the tube withdrawn, cleansed and re inserted

The tube, *which is about 12 to 16 inches long is led out through* the dressing and clamped at its distal end

After-treatment FOOD These patients are usually half starved, so the surgeon may introduce the first feed, such as a few ounces of peptonized milk, whilst the patient is on the operating table

To formulate a suitable diet, the proportions of protein, carbo hydrate and fat have to be considered Also, the actual volume has

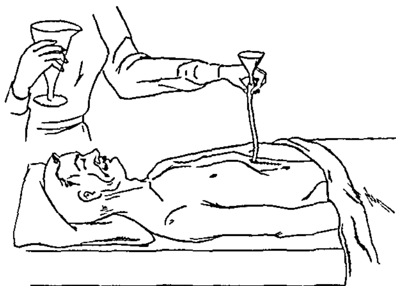


FIG 245 Feeding via a gastrostomy

The stomach will only tolerate food and fluid given very slowly into a gastrostomy and instead of intermittent feeding it is often better to run in fluid from an apparatus similar to that used for intravenous infusions This apparatus is connected to a catheter which has been inserted into the gastrostomy and the fluid is allowed to run in at a rate of 30 to 60 drops a minute Diluted Varco fluid diet is very useful for this purpose

to be carefully calculated in accordance with the patient s original *rather than his present weight*

A patient at rest requires approximately 27 Calories per kilogram of body weight and for a sedentary life 33 Calories

The nourishment chosen is generally fluid in character milk, eggs cream and finely ground cereals constitute the basis of most of the diets which have been recommended and they are introduced by means of a small glass funnel connected to the end of the rubber tube

It must be remembered that owing to disuse the capacity of the stomach is often greatly reduced and only small feeds may be tolerated at first

In general, the patient should be fed every two hours commencing with ℥iv, and gradually increasing the amount However if regurgitation occurs fluid food should be given continuously through

the gastrostomy tube using an apparatus similar to an intravenous infusion set

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THE DRESSING The wound should be inspected daily to see if any regurgitation of stomach contents has taken place On the eighth day the stitches are removed and the tube withdrawn cleansed and re inserted

CONVALESCENCE In most cases the sooner the patient is up and about the better

Complications SHOCK Ample provision should be made to counteract shock which may arise during or after the operation

LEAKAGE OF GASTRIC JUICE AND REGURGITATION OF FOOD When this occurs it is extremely troublesome as it leads to irritation and excoriation of the skin In these cases the skin around the tube should be *protected by a thick layer of ointment, such as mixtures of* starch, egg albumen and olive oil or of zinc oxide ointment and castor oil If necessary, the skin and wound may be sprinkled with powdered bicarbonate of soda to neutralize the acid of the gastric juice

LUNG AFFECTIONS such as broncho pneumonia and atelectasis

ACUTE DILATATION OF THE STOMACH

PERITONITIS

INFECTION OF THE WOUND

HICCOUGH

OVERSEWING OF RUPTURED PEPTIC ULCER

Peptic ulcers of the stomach and duodenum sometimes extend through the muscle to the peritoneum, and rupture or perforation occurs The gastric or duodenal contents are spilled into the peritoneal cavity As these contents are very irritating they damage the peritoneum and the underlying bowel As a result of the latter the organisms in the lumen of the bowel are able to invade the bowel wall and, after a few hours spread through it to the peritoneum *Thus there is at first a chemical peritonitis, but this soon changes to* a *bacterial* peritonitis

Because of the irritation of the peritoneum the patient complains of a sudden severe abdominal pain that becomes even worse, and which is aggravated by movement The patient lies on his side with his knees drawn up in an attempt to relieve the pain His respirations are shallow and he may make a noise at the end of each inspiration because of the increase in the pain that it causes Oversewing of a ruptured ulcer is the commonest operation on the stomach If operation is not performed and the perforation closed he will gradually develop the signs and symptoms of acute peritonitis

At operation an incision is made in the epigastrium The opening in the ulcer is closed with sutures and it is then covered with a piece of omentum

Following the operation the patient is nursed in Fowler s position, breathing exercises are started and the stomach kept empty for a day or so in *order that the perforation may become completely sealed off* Fluids are given at first by intravenous injection whilst gastric aspira tion continues Later fluids are given by mouth starting with one ounce hourly *Penicillin is usually given to help overcome any*

peritoneal infection, and as a prophylactic measure against the onset of pulmonary and wound infections

During the operation some of the spilled gastric or duodenal contents may devitalize the wound edges They are then prone to become infected and healing is slower As a result, wound infection and incisional hernia occur Other complications to be watched for are bronchopneumonia and subphrenic abscess

GASTROTOMY, GASTRECTOMY, GASTROENTEROSTOMY AND VAGOTOMY

As with all surgery, success in gastric surgery depends largely on attention to detail in the treatment of patients before and after operation Not only will skilful nursing and after treatment always add greatly to the patient's comfort, but it will *often save a seemingly hopeless case*

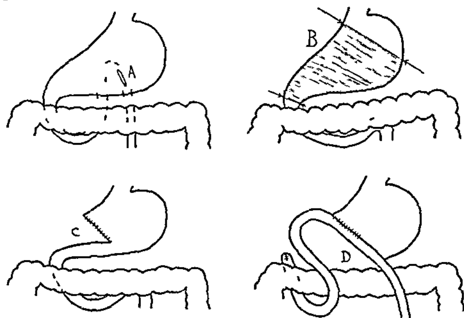


FIG 246 Diagrams of *A* Gastroenterostomy *B* The extent of the stomach removed in a partial gastrectomy *C* The Billroth I method of restoring continuity of the gastrointestinal tract after a partial gastrectomy and *D* The Polya Hoffmeister method of restoring continuity after a partial gastrectomy

Preparation for Operation In the preparation for gastric operations the main points are the hygiene of the mouth the emptying of the stomach and the general condition of the patient

In cases of stomach disease the mouth is often in an unsatisfactory condition and requires especial care and attention Stumps and badly decayed teeth should be extracted the teeth brushed three times a day with carbolic tooth powder, and the mouth frequently rinsed out with some reliable mouth wash

The patient should remain in bed for two days or more preceding the operation, and a gentle daily action of the bowels without purgation should be obtained

In those cases where gastric stasis is present, and is causing dilatation and inflammation, lavage of the stomach with large quantities of sodium bicarbonate solution (½ to 1 teaspoon to the pint) should be carried out two or three times a day

In cases with dehydration and depletion of electrolytes the blood urea is often raised Replacement of the lost water and salts is necessary in order to counteract the occurrence of uræmic symptoms

No solid food should be administered after gastric lavage has been started and the stomach should be completely emptied night and morning by aspiration

When the hæmoglobin is reduced, the oxygen carrying power of the blood is diminished and the patient's chances of recovery are distinctly lowered If the hæmoglobin is below 80 per cent (12 grammes per cent) prior to operation, blood transfusions should be given to restore this to normal During an operation such as a gastrectomy it is good practice to have a transfusion running so that it is possible to counteract shock and loss of blood immediately

If operation is performed immediately after a severe hæmatemesis when the patient is drowsy and stuporose with a low hæmoglobin and a high blood urea the danger to life may be extremely great Fortunately, however careful preparation usually transforms the patient into a good surgical risk

During this preliminary treatment it may be a good plan to accustom the patient to sleeping in the propped up semi sitting position so that it will be found less irksome when adopted after the operation

Whenever there is any likelihood that a total gastrectomy will be performed the chest should also be prepared

After-treatment POSITION As soon as the patient regains consciousness he should be propped up on pillows and encouraged to move his limbs

Unfortunately there is a marked tendency for the patient especially if he is heavy to slip down in the bed and to obviate this a pillow should be fixed at the patient s feet and the foot of the bed slightly raised Deep breathing exercises changes of posture, and movements of the limbs should all be employed in the immediate post operative period in order to lessen the chance of pulmonary complications If the breathing is depressed the surgeon or anæsthetist should be notified and pending their arrival carbogen (carbon dioxide in oxygen) may be given for a few minutes at a time

FLUIDS As with other major operations a fluid balance chart

should be kept after operation Until a urinary output of at least 30 ounces per 24 hours can be maintained, an intravenous infusion should be given The fluid chosen for the infusion will probably be 4 per cent dextrose in N/5 saline, and this will usually be run at about 30 drops a minute in an adult

GASTRIC ASPIRATION Senoran s evacuator is one of the many pieces of apparatus designed for aspirating the stomach, but in its absence gentle suction applied with a syringe to the end of the gastric tube will suffice If no fluid is aspirated, it may be that the tube is blocked and one or two teaspoons of sterile fluid should then be run down the tube to wash it out If the gastric tube is soft, and if suction is vigorously applied, it is obvious that there will be no return since the tube will collapse

DIET The diet after gastric operations is a vexed question, and the practice of different surgeons varies from giving food immediately to giving nothing by mouth for three or even more days However, the majority of surgeons consider it advisable to give milk foods early as these will adsorb, neutralize or dilute the hydrochloric acid, and there should then be less interference with the healing of the suture line in the stomach

The following is a scheme setting out how the diet and fluids may be increased following operations on the stomach always remembering that if any meal causes pain a step back must be made

Day of Operation	Sips of water
2nd day	Hourly feeds of one to two ounces of albumen water equal parts of milk and water, or citrated milk (sodium citrate gr iii to the ounce)
3rd and 4th days	Two to three ounces every hour of albumen water whey citrated milk, or water
5th day	Raw egg beaten up with citrated milk (strength one egg to ℥vii milk) is substituted for three of the milk feeds
6th day on	Semi solid food is gradually added such as lightly boiled or coddled egg jelly ice cream, fish cream or chicken cream
	A cereal such as arrowroot or ground rice boiled in milk, junket or custard (made with eggs not with custard powder)
	White fish or a portion of rabbit or chicken stewed in milk
	Two ounces of water are given orally from now on as required
	Thin slices of bread and butter without crusts

The patient should remain in bed for two days or more preceding the operation, and a gentle daily action of the bowels without purgation should be obtained

In those cases where gastric stasis is present, and is causing dilatation and inflammation lavage of the stomach with large quantities of sodium bicarbonate solution ($\frac{1}{2}$ to 1 teaspoon to the pint) should be carried out two or three times a day

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Whenever there is any likelihood that a total gastrectomy will be performed the chest should also be prepared

After treatment POSITION As soon as the patient regains consciousness he should be propped up on pillows and encouraged to move his limbs

Unfortunately there is a marked tendency for the patient especially if he is heavy to slip down in the bed and to obviate this a pillow should be fixed at the patient s feet and the foot of the bed slightly raised Deep breathing exercises changes of posture and movements of the limbs should all be employed in the immediate post operative period in order to lessen the chance of pulmonary complications If the breathing is depressed the surgeon or anæsthetist should be notified and pending their arrival carbogen (carbon dioxide in oxygen) may be given for a few minutes at a time

FLUIDS As with other major operations a fluid balance chart

or tinned foods, made up dishes, condiments (vinegar, curry, chutney, sauces, etc), new bread, coarse oatmeal
5 Do not take any alcohol until there has been several months freedom from symptoms, and then take it only in strict moderation and well diluted. Take no coffee for many months
6 Take butter and cream freely, and a dessert spoon of olive oil before each meal
7 If possible, give up smoking for three months and thereafter smoke only in strict moderation and not if any symptoms
8 Brush the teeth thrice daily and visit the dentist regularly
9 Take no acetyl salicylic acid (aspirin)
10 Take a teaspoon of an antacid powder or mixture an hour after each meal
11 Keep the bowels regular by liquid paraffin or magnesia
12 If a cold, sore throat, influenza or other infection develops, rest in bed on a light diet until recovery is complete
13 Make it a practice to take regular exercise

THIRST may be almost intolerable after gastric operations and should be alleviated by intravenous infusion

BOWELS After three or four days when the patient begins to complain of gas pains an enema may be given but only if ordered by the surgeon

THE WOUND The wound should be redressed on the eighth day and the stitches removed between then and the twelfth day

SLEEP On the night of the operation, if the patient complains of pain a hypodermic injection of morphia or pethidine is given and repeated as required

If the patient finds the Fowler s position irksome he may be partially turned on to his side at night After three or four days he may be permitted to sleep in the lateral position

DURATION OF REST IN BED There is great difference of opinion amongst surgeons as to how long a patient should be kept in bed after a gastric operation or indeed after any operation but as a rule these patients use a couch after a few days and spend a longer time out of bed each day

ESTIMATE OF SUCCESS OF VAGOTOMY As a means of determining whether all branches of the vagus nerves to the stomach have been divided at the time of the vagotomy an Insulin Test Meal may be performed both before vagotomy and at some time afterwards This test depends on the fact that an injection of insulin lowers the blood sugar and this stimulates the vagus centres in the brain Before operation such stimulation causes the secretion of hydrochloric acid in the stomach but if the nerves have been completely divided this effect is abolished

6th day on (*continued*) — When feedings are started after any gastrectomy the feeds should be small in size *e g* ℥i to ℥ii, as the capacity of the stomach is small Also the tolerance of the jejunal loops to more than a few ounces is very limited The feeds may, however, be more frequent than in the above scheme, but they should not be increased in size for some weeks

For the first month soft and very easily digested food should be given in frequent small meals Subsequently the diet should still be restricted in quantity for at least twelve months During this time cream, milk and milk foods eggs, bread butter fish fowl, tripe, rabbit, brains, chops steak, fruit and vegetables should form the basis of the diet

If the meals are followed by discomfort, the quantities should be reduced and more frequent meals taken

Most surgeons advocate aspiration of the stomach after operation so that there will be no retention of fluid and of gas which might cause pressure on the suture line This is usually carried out for only the first day or two but with patients who have had a vagotomy or a total gastrectomy performed prolonged aspiration is required

After vagotomy the contractile power of the muscle of the stomach is greatly diminished but this gradually improves At first, it is easily overstretched and if the stomach is not kept empty for a few days after vagotomy this overstretching often results in permanent paralysis of the muscle

After a total gastrectomy the œsophagus is usually joined to the jejunum The œsophagus has no peritoneal covering and the junction of the œsophagus to the jejunum is more likely to leak than when two peritonealized portions of the alimentary tract are joined together Accordingly, many surgeons prefer to aspirate the contents from the œsophagus for more than one or two days after this operation

In those patients in which operation on the stomach has failed to reduce the gastric hyperacidity the following *regime* should be adopted permanently

1 Take Regular Meals Eat slowly and chew very thoroughly Rest for fifteen minutes before and after meals
2 On waking between breakfast and lunch between lunch and tea and before going to bed take a very light meal *e g* Benger s food or citrated milk Take a glass of milk if awake during the night
3 Avoid all raw vegetables whether taken alone or in pickles or a salad Cooked green vegetables should be passed through a sieve and mixed with butter in the form of a puree
4 Avoid sour fruit pips and skins of fruit (currants raisins figs, lemon peel nuts etc), meat soups pork, tough meat salted

or tinned foods, made up dishes, condiments (vinegar, curry, chutney, sauces, etc), new bread, coarse oatmeal

5 Do not take any alcohol until there has been several months freedom from symptoms, and then take it only in strict moderation and well diluted Take no coffee for many months
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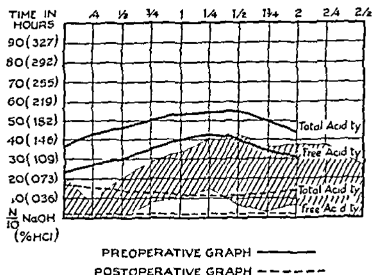


FIG 247 The shaded area shows the limits of free hydrochloric acid (HCl) in normal persons after a test meal of gruel
The two continuous graphs show the total and free acidity before gastrectomy in a patient with a duodenal ulcer and the interrupted graphs show the acidity in the same patient after gastrectomy

Complications of Gastrectomy and other Gastric Operations Owing *to the greater care in the preparation and after treatment of these* cases and also to the improvements in operative technique and anæsthesia these complications have now become much less common

HÆMORRHAGE When this occurs it is usually about twenty four to forty eight hours after operation and generally arises from imperfect suturing In rare instances it is due to damage to the gastric mucous membrane or to a peptic ulcer which has not been removed

In all these cases oral feeding should be omitted at once and nothing be given by mouth (except perhaps half drachm doses of liq adrenalinæ hydrochloridi in a little water every two hours) The *stomach should be washed out by means of a soft rubber stomach* tube a hypodermic injection of morphia administered and a blood transfusion started

In such cases quarter hourly examinations of both blood pressure and hæmoglobin percentage should be carried out

PULMONARY COLLAPSE Unless energetic measures are taken pulmonary collapse (atelectasis) frequently develops after gastric operations especially in feeble patients

The shallow post operative breathing leads to an accumulation of bronchial secretion and if the cough reflex fails to expel this mucus a section of the bronchial tree may become blocked

Pulmonary collapse is therefore best prevented by nursing the patient in the semi recumbent position avoiding too generous use of opium or its derivatives lest the expulsive cough so essential for

clearing the bronchi of secretion is abolished, breathing exercises, and frequent movements and changes in posture If specially ordered, carbogen (carbon dioxide in oxygen) will be inhaled for a few minutes hourly

When once developed the treatment of pulmonary collapse does not differ from that described in a previous chapter

INTESTINAL OBSTRUCTION In these cases a piece of small intestine may slip through an artificial opening in the mesentery of the transverse colon (mesocolon) or around the loop formed by the jejunum and become strangulated In other cases obstruction is due to a jejunal loop which has become adherent to a suture line and then twisted The signs of acute intestinal obstruction will be present and the condition will necessitate immediate operation for its relief

JEJUNAL ULCER, or gastro jejunal ulcer, occurs usually after a gastro enterostomy and less often after subtotal gastrectomy for the treatment of peptic ulcer It is characterized by the development of an ulcer in that part of the jejunum bordering on the anastomosis or at the junction between the jejunum and the stomach

The symptoms suggest a recurrence of the ulcer for which the operation was performed and it should first be treated medically *i e* by rest in bed dieting and the administration of alkalis etc , to neutralize the acidity of the gastric juice If the above measures fail either a vagotomy or a gastrectomy with removal of the ulcer must be performed

DIARRHŒA If oro naso pharyngeal sepsis has not been eradicated prior to the operation the loss of the customary antiseptic barrier formed by the normal acid gastric juice when achlorhydria is present may cause infection of the small intestine and an enteritis, set up by the mechanical irritation of undigested food, is aggravated by the invasion of bacteria

Diarrhœa from this cause can usually be controlled after infective foci in the mouth nose and throat have been eradicated by giving a non irritating diet with little cellulose or starch and by the use of bismuth atropine, and possibly codeine

DUMPING SYNDROME Amongst the unpleasant after effects of gastrectomy is rapid emptying of the stomach and the collection of food and fluid in the jejunum This not only leads to imperfect digestion but also tends to cause abdominal discomfort diarrhœa and a feeling of weakness Small and frequent feeds which contain little or no sugar and which are very thoroughly masticated generally lead to a gradual adaptation of the jejunum and the disappearance of unpleasant symptoms Relief is also usually obtainable if the patient lies down for half an hour after each meal and from the use of small doses of atropine and of phenobarbital

SUBPHRENIC ABSCESS If leakage occurs from the suture line, a

localized abscess may form *i e* a perigastric abscess, and from this infection may spread to one of the subphrenic spaces

REGURGITANT VOMITING This may occur within the first few hours or days after a gastro enterostomy, and is usually due to obstruction occurring at the anastomosis, *i e* a kink forms and the contents of the duodenum instead of passing along the small intestine are regurgitated

If vomiting takes place after a gastro enterostomy, the patient should be placed in the Fowler position, the stomach aspirated continuously, and fluid replaced by intravenous infusion

If the vomiting persists despite these measures, the patient will be prepared for operation and an anastomosis established between the two limbs of the jejunal loop that was used for the anastomosis This allows free exit of duodenal contents into the intestine

SMALL INTESTINE

The operations performed on the small intestine include —

Enterotomy The small intestine is temporarily opened for the removal of a foreign body accidentally swallowed a gall stone etc It is then closed

Enterostomy An opening is made in the small bowel and a tube is inserted It was formerly used to introduce nourishment into the upper jejunum (*jejunostomy*) as a pre operative measure in seriously ill cases of carcinoma of the stomach and it is now used to drain the ileum (*ileostomy*) in some cases of chronic ulcerative colitis and of familial polyposis

Ileostomy The application of an adherent ileostomy bag at the time of making the ileostomy (and the wearing of it constantly thereafter) should prevent contact of the very irritating ileal contents with the skin The opening in such a bag is cut so that it only just accommodates the ileal stoma

If an efficient adherent bag is not worn protection of the skin (with pastes etc) should start from the time of operation Usually, these bags are changed every three to six days

A non adherent bag should have a soft smooth round margin so that, when it moves it will not injure the ileal stoma

Various preparations have been suggested for application to the skin in such cases but before irritation occurs the best of them seem to be aluminium paste (composed of aluminium powder zinc oxide and liquid paraffin) and tinctura benzoini co (Friar s Balsam) frequently applied After irritation and excoriation of the skin have developed Cattell recommends the application of a 5 per cent solution of tannic acid for fifteen minutes when the skin is dried and coated with Fuller s Earth

As an alternative Silicone Vasogen is a commercial preparation well

worth a trial If the skin becomes very sore hydrocortisone cream or Karaya gum may be tried

In the *Lancet* of 1945 (Volume I, page 240) Selous and Perryman described an acid jelly with a pH of 5 0 containing potassium hydrogen phthalate, sodium hydroxide, chlorbutol gelatin, agar and water for application around the opening of an ileostomy

An egg diet, which includes the whites of two eggs four times a day has been said to be useful in lessening the irritation

The patient with a permanent ileostomy needs to wear a bag to receive the bowel contents This may be glued to the skin with a latex solution, and it is emptied as required through the lower end If a non adherent bag is worn, it is changed and cleansed every two to four hours

The addition of three or four teaspoonfuls of powdered wood charcoal to the bag helps to keep down the odour of the bowel contents also, it renders the contents less fluid and therefore less liable to leak between the bag and the abdominal wall

The liquid consistency of the discharge will also be slightly lessened by taking chalk and kaolin powders and by the avoidance of excess fruit and vegetables

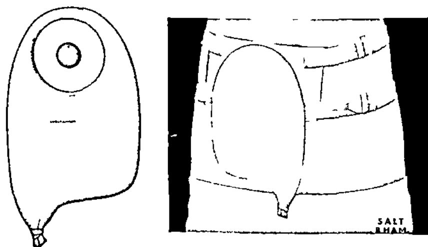


FIG 248 Salt and Son s ileostomy bag back and front views

In cases of spasm atropine a sedative (such as phenobarbitone) and sometimes extra salt may help

The patient with an ileostomy is apt to lose fluid quickly and it must be quickly replaced

Adherent ileostomy bags are supplied by Salt and Son (Fig 248) and by Down Bros and Mayer and Phelps (Fig 249) They have been developed from the Koenig Rutzen bag However there is no

ileostomy bag that is suitable for all individuals, and many types of bag are available

The following instructions are issued by Salt and Son Ltd to those using their adherent bags —

(i) Cleanse the skin around the ileostomy with cotton wool moistened with either benzene or naphtha Wash with soap and water and dry *thoroughly* The benzene or naphtha should be used sparingly as in some cases there is a tendency for it to cause skin irritation

(ii) Apply a coating of the adhesive compound to the skin and to the circular face piece and allow it to dry to a tacky" consistency This is important as it ensures a closer seal between the skin and face piece Apply the face piece to the body with gentle pressure and hold it in position for several minutes, then fasten the rubber belt firmly but comfortably

(iii) To remove the face piece from the body a small quantity of benzene dropped directly on the skin will loosen the face piece painlessly Adhesive solution remaining on the skin may be removed by cotton wool moistened with benzene The skin should then be washed with soap and water and dried thoroughly

(iv) It is not advised that the solution is removed daily from the face piece as the slightly uneven surface resulting from successive applications gives a better sticking surface It is usually found sufficient to clean the face piece once or twice a week but experience will show the methods most suitable in each individual case Care should be taken that the benzene does not enter the bag itself as it will cause the sides to stick together

The lower outlet of the bag of Salt and Son Ltd is closed with a *rubber band twisted over it many times or with a metal clip*

Cleaning Instructions (a) The bags should be washed immediately they are emptied whenever possible using warm soapy water to which a little disinfectant has been added The use of a soft brush round the seams will be of advantage After washing the bags should be hung up by the hook inside out in a current of air, away from direct heat Frequent changing of the bags will help to prevent any odour

(b) The outer surfaces of the bag may be kept clean by wiping with cotton wool moistened with benzene and by applying talcum powder

The Chiron ileostomy bags supplied by Down Bros and Mayer & Phelps are similar to those of Salt and Son but they have a vulcanite outlet and are attached to the skin with double sided adhesive plasters 4 × 3 inches

For the application of their ileostomy bags Down Bros and Mayer & Phelps suggest that —(i) Holes are cut (to fit the stoma) in the *rubber flange which holds the bag and in the special adhesive plaster* (ii) Then, having removed the cover from one side of the special adhesive plaster the flange and the exposed side of the adhesive plaster

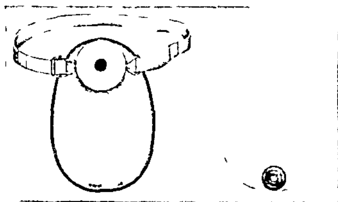


FIG 249 The Chiron ileostomy bag back and front views

are pressed together (iii) The skin is cleansed with methylated spirits (but not with spirit containing any oil which would not allow the plaster to adhere) and then it is sprayed with Nobecutane (iv) After the Nobecutane has dried the plaster with flange attached is pressed firmly on to the skin (v) Before fixing the bag to the rubber flange a small amount of aluminium paste is applied around the stoma and it is also encircled with a small roll of cotton wool about a quarter of an inch in diameter This helps to prevent seepage of fluid under the inside of the adhesive plaster (vi) The bag is now pulled over the flange and the belt is fixed in position

(vii) As a further safeguard for swimming and bathing pieces of waterproof adhesive strapping are applied down the four sides of the special adhesive plaster (viii) For cleaning the bag may be turned inside out, and finally it should be dried and powdered with Veemo powder (Johnson & Johnson) The latter is of some help in preventing the development of an odour in the rubber of the bag itself

Some ileostomy bags are made of polythene and can be discarded after use If two of these disposable bags are worn together one inside the other there is added protection, and the second bag is at hand when required

In many large cities including London New York Los Angeles Boston Johannesburg Sydney and Melbourne, associations or clubs known as the Q T Associations have been formed so that patients with ileostomies can meet together and help each other with moral support and with hints about the management of the ileostomy

Enterectomy The term enterectomy means resection of part of the small intestine

Entero-Anastomosis or Short Circuiting consists in the diversion of the intestinal contents from their normal channel and is generally employed to overcome irremovable stenosis of the intestine

Preparation for Operation All operations in which opening of the lumen of the small intestine is contemplated, call for the same local and general preparation as do gastric operations, but, in addition if there is time the bowel is prepared with one of the non absorbable sulphonamides or with an antibiotic as described in Chapter 26

When, however the operation is performed urgently for the relief of acute intestinal obstruction the preparation of the patient as regards the alimentary canal should be restricted to gastric aspiration and perhaps the emptying of the colon by enemata

After-treatment The after treatment of operations on the small intestine is practically identical with that adopted after gastric operations, but the diet bowels and skin require special mention

DIET In a general way it may be said that the lower down, *i e* the nearer the anus is the portion of the bowel involved in the operation, the sooner may the diet be increased An average diet would be —

Day of Operation	Sips of water
2nd day	Milk, Benger s Food jelly, etc two hourly by day and when awake at night
3rd day	Custard jelly and junket, chicken broth, bread and milk
4th day	Fish cream, chicken cream, bread and butter, eggs
5th day	Minced chicken, boiled fish etc
10th day	Ordinary diet

BOWELS The bowels should be kept quiet for some days following the operation in order to conserve repair After the small bowel has been incised the lower bowel may be emptied by suppositories where necessary but no aperients should be administered by mouth before the tenth day

THE SKIN In enterostomy cases as has already been mentioned, great care must be taken of the surrounding skin for the intestinal contents cause irritation

Complications of Intestinal Operations FAILURE OF SUTURE The stitches at the line of union may cut through thus allowing leakage of the intestinal contents with the formation of a general or localized peritonitis or an external *fæcal* fistula

STITCH ABSCESSES may form at the line of union owing to infection of the sutures and although not usually dangerous to life they may give rise to adhesions which interfere with normal peristalsis

ADHESIONS Owing to stitch abscesses, to slight leakage from the line of union or to the oozing of blood adhesions may develop between the anastomosis and either the neighbouring abdominal viscera or the abdominal wall and kinking of the intestine may result, giving rise to acute intestinal obstruction

PERITONITIS may arise from infection of the peritoneal cavity during

the performance of the operation or from leakage of the suture line later on When it is probable at operation that infection has taken place, free drainage will usually be established as a prophylactic measure to avoid a spreading peritonitis

STENOSIS OF THE ANASTOMOTIC OPENING may occur in rare instances after enterectomy This gives rise to symptoms of chronic intestinal obstruction

COLON

Operations on the Colon The common operations performed on the colon are —

COLOTOMY This operation of temporarily opening the colon is rarely undertaken, then it is for the removal of a polyp or an impacted foreign body

COLOSTOMY (often erroneously called Colotomy) consists in the formation of an artificial opening in the colon to allow evacuation of fæces It is usually performed either as a preliminary to or at the time of excision of the colon or as a palliative operation for certain inoperable cases of carcinoma of the colon or rectum

COLECTOMY consists in the removal of part or the whole of the large intestine, with or without the re establishment of the continuity of the alimentary canal by intestinal anastomosis

The preparation for colectomy is the same as that laid down for excision of the rectum, and the after treatment does not differ materially from that already described for enterectomy

The chief indication for colectomy is in cases of carcinoma of the colon but it is also indicated in the presence of diverticulitis and chronic ulcerative colitis when various complications arise, for example strictures fistulæ or persistent hæmorrhages A much less common indication for colectomy is in cases of familial polyposis

Some surgeons combine *cæcostomy* (drainage of the cæcum) with colectomy in order to reduce the pressure in the bowel and thus aid the healing of the suture line However blockage of a cæcostomy catheter is very likely and, to lessen this possibility such a catheter is usually irrigated with ℥i to ℥ii of saline several times daily This catheter is removed after one to two weeks when the opening being vascular sometimes closes spontaneously

Instead of re establishing the continuity of the bowel by a sutured anastomosis this may be carried out in several stages by the Paul-Mikulicz method After excising the affected loop of bowel continuity is later restored in a similar manner to that used for other colostomies with a sutured spur *i e* an enterotome is applied to crush the spur of the colostomy and then, after a further delay while the inflammatory reaction subsides the single opening is closed (Fig 256)

By the time a patient with chronic ulcerative colitis is submitted

to operation the general condition is almost always very poor and it is unlikely that the convalescence will be smooth In addition to their poor physical state these cases often have psychological changes which require careful consideration

The special complications of colectomy are similar to those described above when discussing operations on the small bowel

Colostomy

Preparation for Operation On the patient s admission there is often some degree of intestinal obstruction, and hence only the surgeon should decide the advisability of giving aperients or enemata

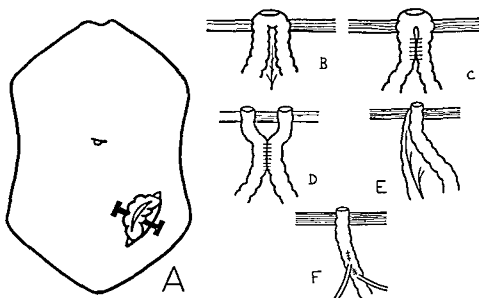


Fig 250 *A* A loop colostomy in the left iliac fossa The bowel is held in position by a glass rod with a piece of rubber tubing on each end and these pieces of rubber tubing in turn hold the glass rod in place *B* A loop colostomy in cross section with its mesentery and blood vessels between the loop *C* A loop colostomy with a sutured spur *D* A defunctioning colostomy with the two ends separated after the method of Devine *E* An end colostomy with its mesentery and blood vessels *F* A wet colostomy with the ureters implanted into the colon

Varieties of Operation The operation may vary somewhat according to whether a permanent or temporary opening is required

In each case the surgeon withdraws a loop of colon (Fig 250) from the abdomen fixes the loop in position by a glass rod passed through the mesentery and either then or in a day or so opens the exteriorized bowel In some cases in which the colostomy is to be permanent the two edges of the incision are united through a hole in the mesentery so that a bridge of skin is formed and retraction of the loop is prevented

After treatment If, at the operation it is necessary to open the bowel, a Paul's tube (Fig 251) may be tied into it This affords drainage and it is connected to a rubber tube of large calibre, some what similar to the inner tube of a bicycle tyre, which is, in turn, led into a suitable receptacle fastened to the side of the bed, and partially filled with 1 in 40 phenol or other antiseptic

The portion of the bowel on the abdominal wall is covered with gauze soaked in ' Vaseline or liquid paraffin If dry gauze is used for the dressing, it becomes adherent to the bowel

If the colostomy was not opened at the time of the operation, the dressing is left untouched for one or two days and then it is removed and the bowel opened If a diathermy knife is available, its use limits the amount of the bleeding

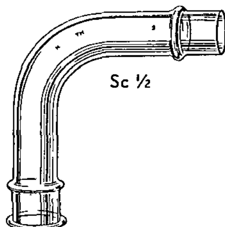


FIG 251 Paul s colostomy tube which is sometimes inserted into a colos tomy at the time of operation especially in cases of acute intestinal obstruction
Once the fæces become more solid this tube is removed This tube is available in three sizes ½ ⅝ and ¾ of an inch in diameter

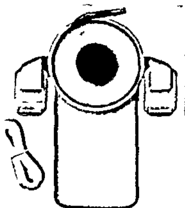
The opening of a colostomy is usually carried out in the ward no anæsthetic is necessary The sterile tray to be used should contain 6 Spencer Wells artery forceps 2 dissecting forceps (one toothed and one non toothed) 2 scissors (one dissecting scissors and one suture scissors) No 0 catgut for the ligatures gauze swabs and Vaselined gauze

When a de Martel s or Cope s clamp has been applied in the operating theatre the colostomy is opened by removing that clamp For this a special lever two pairs of dissecting forceps and some swabs will be required

If a Paul s tube has been inserted this is usually set free about the fourth to the sixth day but by that time the bowel is adherent to the wound and there is no risk of infecting the peritoneal cavity

As the dressings of the colostomy may have to be changed frequently they are usually fixed in position by a many tailed bandage or a binder

End Colostomy The type of colostomy discussed above is a loop ' colostomy When the colostomy is made at the time the rectum is




A B

FIG 252 Davol rubber colostomy bags

A Front view without wire frame The inflatable pneumatic rim provides a comfortable fit *B* Back view showing the wire frame

removed the end of the bowel is brought out through the abdominal wall as an end colostomy The bowel is then fixed to the abdominal wall by sutures or by a glass rod through the mesentery

After-treatment DIET A light nourishing and stimulating diet

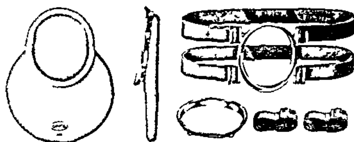


FIG 253 Hanna style of Davol colostomy bag with metal ring and webbing straps

should be instituted but the patient must avoid those articles of food which are likely to cause diarrhœa It should include items such as orange juice bread toast butter eggs bacon meat potatoes shredded lettuce (limited) cheese jelly ice cream, bananas milk and tea

BOWELS Even if the colostomy has been opened at the time of the operation it is unusual for it to act during the first few days If there has been no action after three days a mild aperient such as an ounce of a mixture of equal parts of liquid paraffin and Milk of Magnesia (Milpar) should be given each night If ordered by the surgeon, but

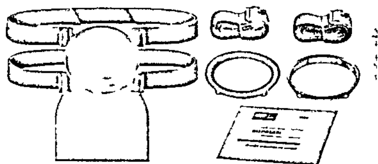


FIG 254 Disposable type of Davol colostomy bag This is also available with a light weight flexible body ring which can be cemented to the skin

not otherwise, a bowel wash out is given into the upper end of the divided bowel

A useful bedpan may be improvised from an enamel bowl four inches deep and six inches wide covered by a plastic material fixed in position by a rubber band, and having a hole cut in the centre large enough to admit the colostomy opening The bowl is surrounded by an inflated air cushion and the patient then placed in the semi prone position for half an hour so that the colostomy opening projects through the centre hole in the material

If there is a tendency to looseness in the stools a five grain tablet of pulv ipecacuanhæ et opii once or twice a day or suitable doses of pulv cretæ aromaticus or kaomagma should be administered Other preparations of use when the stools are loose are kaolin, activated charcoal and methyl cellulose

THE WOUND All stitches should be removed about the eighth day If the fæces irritate the skin in the region of the colostomy it should be protected by an application such as cremor zinci

The skin around a colostomy should be cleansed with soap and water and dried after each bowel action

RECEPTACLE After about a month some regularity of action of the colostomy may be expected but it often takes several months before this becomes satisfactory

A popular colostomy apparatus is that supplied by the firm of Davol It consists of an almost flat oval cup with a pneumatic rim which is fitted over the opening and retained in position by a belt

This and other similar appliances have the disadvantage that unless disposable plastic linings or disposable bags are used cleaning the bag or cup whenever it is soiled is a great nuisance Also no matter how carefully the container is cleansed it soon becomes impossible to obliterate the fæcal odour which the rubber or other material acquires

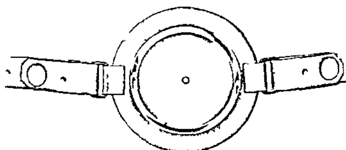
When the bowel actions have been reduced to one or two a day the cup or bag may well be replaced by a small dressing A dough nut' of cotton wool, that is a ring of cotton wool about three inches in diameter and one inch thick, is placed around the colostomy This is covered with a layer of cotton wool on the outside of which is placed a piece of waterproof material, and this is all held in place by a canvas or elastic binder If necessary, a thin metal or plastic disc is worn under the binder for support If step ins are worn, the binder will not be required

A good type of colostomy belt is one made from two way stretch elastic six to eight inches wide, such as is used for making women s girdles

If it is available, soluble cellulose wadding is preferable to ordinary cotton wool as it is cheaper and it is not likely to block a water closet Cotton wool is best disposed of by burning

A rubber belt with a fixed rubber ring may be worn as a bathing shield by those patients who wish to go swimming

Some colostomy bags may be glued onto the skin These bags are similar to adherent ileostomy bags but there is usually very little



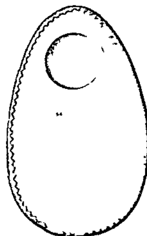


FIG 255 Salt and Son s wet colostomy apparatus

This is a modification of Pearce s apparatus and is used when one or both ureters have been transplanted into the colon above a colostomy It is also useful for some patients with ileostomies

The face piece (above) is of rubber mounted on a metal ring The central hole is enlarged with scissors to the shape and size of the colostomy or ileostomy bud Adhesive solution is applied to the face piece

For cleaning the rubber bag is detachable from the ring of the face piece without detaching the face piece from the skin

trouble with irritation of the skin around an ordinary colostomy and such bags are rarely used However, for the patient who is very worried lest the colostomy dressing is displaced at night and for the patient with a wet" colostomy, adherent colostomy bags can be very useful

WET COLOSTOMY If the ureters are implanted into the colon above a colostomy, this is called a wet ' colostomy Such diversion of the urinary stream is sometimes necessary in extensive operations for cancer in the pelvis where the terminal ureters and bladder are removed with the rectum

Patients with a wet colostomy may be advised to wear the Pearce wet colostomy bag (Fig 255) This is an adaptation of the adherent ileostomy bag, and the care of the bag and of the skin around the wet colostomy is the same as when an ileostomy is present

The instructions issued by Salt and Son Ltd with their wet colostomy apparatus is as follows —

The face piece of the apparatus is of rubber, mounted on a metal ring The small central hole is enlarged with sharp scissors to the shape and size suitable for the colostomy bud , and the face piece is then ready for the application of the adhesive solution

' The rubber bag being detachable from the ring of the face piece without removal of the face piece from the body can easily be emptied and turned inside out for scrubbing rinsing and disinfecting after use

The rubber waist belt, having a stud fastening, is easily detached and can also be washed when necessary

CARE OF A COLOSTOMY

The colostomy should be trained to act once daily and then at the same time each day

Whenever anything enters the stomach there is a reflex stimulation of peristalsis in the bowel Thus in order to reduce the number of colostomy actions per day the following regime is advised —

The meals are limited to three per day and fluids are drunk with meals No food or drink is taken between meals

One of the meals is much larger than the others and it will be found that the colostomy will usually act after that meal In some cases there will be smaller actions after the other two meals

If difficulty is being experienced in producing regular action of the colostomy the left side of the abdomen should be massaged after breakfast and a glycerine suppository should then be inserted into the colostomy and held there

If twenty four hours pass without evacuation or there is any tendency to constipation one or two drachms of liquid paraffin or Isogel may be given at bedtime

Most patients prefer to train the colostomy to work each morning, but this requires the use of the lavatory and bathroom for more than half an hour, thus in the home in which the toilet facilities are limited it is often advantageous to obtain the colostomy action in the evening

In the early stages of the post operative period a mixed low residue, high protein diet is advisable and then later the diet is gradually increased but nuts, vegetables like cabbage and the skins and pips of fruit must be avoided If the addition of any particular food produces loose stools that item should be omitted thereafter So that such unsuitable foods may be recognized the diet should be increased by a single item at a time It is usually found that curries and highly spiced food cause too loose an action

A few surgeons prefer to have the colostomy washed out each morning This has the advantage that usually this is the only action of the colostomy in the day but on the other hand it carries the definite risk of peritonitis The risk arises from the fact that the bowel wall is insensitive to ordinary painful stimuli so that the tube for the wash out may be pushed through the bowel wall unknowingly Then when the fluid is run in infection is distributed throughout the peritoneal cavity and may quickly cause a fatal peritonitis

If the colostomy is to be washed out the softest catheter should be passed as gently as possible along the bowel The fluid should be run in from a height of not more than a foot above the patient and the flow should be stopped immediately there is any complaint of pain Usually about three pints of fluid will be required for such a wash out, and the whole procedure will take from fifteen to sixty mintues

Many patients overcome their dislike for the colostomy if they wear rubber gloves when dealing with it, and this should be suggested to them

Nylon underwear is advisable for patients with a colostomy (or ileostomy) as this material is easy to clean after an accident

Complications of Colostomy PROLAPSE OF THE INTESTINES Small intestine may escape between the colostomy loop and the edges of the wound It gives rise to pain vomiting and collapse and the dressings become soaked In these cases the prolapsed intestine will require cleaning and returning to the abdomen and the wound will be re sutured

FAILURE OF THE COLOSTOMY TO ACT This should be treated by mild aperients at first but eventually a bowel wash out will sometimes be required

CELLULITIS OF THE ABDOMINAL WALL occasionally occurs as the result of infection due to imperfect adhesion of the bowel to the abdominal wall

PERITONITIS may arise from infection of the peritoneal cavity either during the operation or by the subsequent spread of infection

Falling Back of the Colostomy Loop into the abdominal cavity occasionally occurs because of imperfect fixation of the loop at the time of operation, the inadequate production of adhesions, or sloughing of part of the bowel The last named is the most likely

Prolapse of the Mucous Membrane of the Colon The pressure in the abdomen and the peristaltic waves may force the colostomy opening to roll out so that more bowel protrudes This may then interfere with the wearing of a colostomy apparatus

Contraction of the Colostomy Opening If the colostomy opening contracts it must be dilated with the finger or by means of a special dilator, such as the St Mark s Hospital rectal dilator If the narrowing continues operative enlargement will be required

Hernia Formation The site of passage of the colostomy loop through the abdominal wall constitutes a weakness in the abdominal musculature and, as a result of coughing and straining, a definite bulging or even herniation of the muscle may develop

Colostomy Closure

If the two limbs of the colostomy loop have been sutured together at the time the colostomy was constructed the adjoining portions of the bowel wall will be crushed by an enterotome as the first step in the closure This crushing usually takes several days and is accompanied by some nausea and discomfort due to the pressure on the

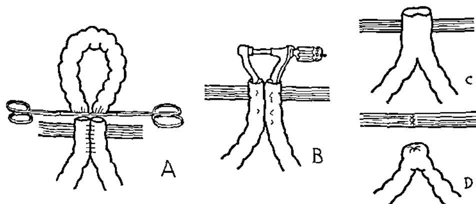


Fig 256 Diagrams showing the steps of Paul Mikulicz s operation

A The loop of exteriorized colon containing the lesion is excised *B* The spur of the colostomy is crushed with an enterotome *C* The enterotome is removed and *D* The opening into the colon is closed

mesentery No anæsthetic is required for the application of the enterotome Some time after the spur has been crushed the bowel is dissected free from the abdominal wall the opening closed with sutures and then the bowel is dropped back into the abdomen The wound is closed around a small drain tube This is called *extra peritoneal* closure

Most patients prefer to train the colostomy to work each morning, but this requires the use of the lavatory and bathroom for more than half an hour thus in the home in which the toilet facilities are limited it is often advantageous to obtain the colostomy action in the evening

In the early stages of the post operative period a mixed low residue high protein diet is advisable, and then later the diet is gradually in creased but nuts vegetables like cabbage and the skins and pips of fruit must be avoided If the addition of any particular food produces loose stools that item should be omitted thereafter So that such unsuitable foods may be recognized, the diet should be increased by a single item at a time It is usually found that curries and highly spiced food cause too loose an action

A few surgeons prefer to have the colostomy washed out each morning This has the advantage that usually this is the only action of the colostomy in the day but on the other hand, it carries the definite risk of peritonitis The risk arises from the fact that the bowel wall is insensitive to ordinary painful stimuli so that the tube for the wash out may be pushed through the bowel wall unknowingly Then when the fluid is run in infection is distributed throughout the peritoneal cavity and may quickly cause a fatal peritonitis

If the colostomy is to be washed out the softest catheter should be passed as gently as possible along the bowel The fluid should be run in from a height of not more than a foot above the patient and the flow should be stopped immediately there is any complaint of pain Usually about three pints of fluid will be required for such a wash out, and the whole procedure will take from fifteen to sixty mintues

Many patients overcome their dislike for the colostomy if they wear rubber gloves when dealing with it and this should be suggested to them

Nylon underwear is advisable for patients with a colostomy (or ileostomy) as this material is easy to clean after an accident

Complications of Colostomy PROLAPSE OF THE INTESTINES Small intestine may escape between the colostomy loop and the edges of the wound It gives rise to pain vomiting and collapse and the dressings become soaked In these cases the prolapsed intestine will require cleaning and returning to the abdomen and the wound will be re sutured

FAILURE OF THE COLOSTOMY TO ACT This should be treated by mild aperients at first but eventually a bowel wash out will sometimes be required

CELLULITIS OF THE ABDOMINAL WALL occasionally occurs as the result of infection due to imperfect adhesion of the bowel to the abdominal wall

PERITONITIS may arise from infection of the peritoneal cavity either during the operation or by the subsequent spread of infection

CHAPTER 26

THE RECTUM AND ANUS

THE chief diseases of the anus and rectum for which operations are commonly performed are —

1 **Hæmorrhoids or Piles** These consist of dilated veins in the upper part of the anal canal and they may bleed, clot, or prolapse through the anus

2 **Ischiorectal Abscess** This is an abscess in the ischiorectal fossa, and following incision it may heal or it may lead to a fistula in ano

3 **Fistula In Ano** This is a tunnel leading from the bowel to the skin and is associated with infection in the tissues around it

4 **Anal Fissure** An ulcer about $\frac{1}{4}$ to $\frac{1}{2}$ inch long and from $\frac{1}{16}$ to $\frac{3}{8}$ inch wide on the anal margin, usually in the midline posteriorly and usually associated with severe pain

5 **Rectal Polyp** This may be a true polyp that is, a benign tumour of the rectum, or it may originate as a fibrotic hæmorrhoid which has developed a stalk or pedicle

6 **Rectal Prolapse** A condition where part or the whole of the rectal wall passes to the exterior through the anus

7 **Carcinoma of the Rectum and Anus** A cancer that is a malignant growth arising in the rectum or anus

Pilonidal sinus is a condition occurring over the back of the sacrum but it is not connected to the bowel Pilonidal sinuses probably develop around loose hairs which become embedded in the skin of the natal cleft After excision the treatment of the wound is somewhat similar to that of the wound following operations for anal fistulæ

RECTAL EXAMINATION

In preparation for a rectal examination the nurse should have ready —

(i) a rubber finger stall with petticoat or a rubber glove
(ii) a receiver with swabs
(iii) soft yellow paraffin or other lubricant such as KY jelly
(iv) a proctoscope This must of course be cooled before use

For rectal examinations the patient is placed in the knee chest position or lies on the left side with the knees well drawn up and with the buttocks projecting slightly over the side of the bed

The parts should be so exposed that a good view is obtainable of

If the two limbs of the colostomy loop have not been sutured together, the colostomy will be closed at operation without crushing a spur The operation then resembles an anastomosis following a bowel resection and it is called an *intraperitoneal* closure

(i) *Partial Incontinence* occurs when firm and well formed motions are normally retained and evacuated at will, but liquid stools and flatus escape involuntarily

(ii) *Complete Incontinence* on the other hand occurs when neither stools nor flatus can be retained in the rectum and are discharged without warning in spite of all efforts to retain them

In true incontinence the anal region and buttocks may be constantly moist, excoriated and covered with fæces, and there is a great risk of developing bed sores

Hence directly a motion is passed the patient must be washed and the bed changed Everything should be done to render the stools solid in consistency, and thus to prevent their *continuous* discharge The diet should consist of those foods known to exert a constipating effect, and opiates should be administered in order to allay peristalsis The parts should be cleansed frequently and covered with some soothing ointment to prevent the excoriation and the pruritus which develops if the perianal skin is continually moist

FALSE INCONTINENCE DUE TO FÆCAL IMPACTION Owing to intestinal stasis fæces may collect in the rectum After a time the fluid part is absorbed, and this gives rise to a large hard fæcal accumulation which interferes with the action of the sphincter muscles This accumulation excites inflammation of the mucous membrane of the rectum, and the increased mucous secretion produced mingled with fæces, escapes through the incompetent sphincter The condition is at once recognized on rectal examination, when the hard fæcal mass is readily felt in the lower rectum

For its removal repeated enemata and purges may suffice in the milder cases but in the severer ones a general anæsthetic will be required in order to break up the mass with the finger The fæces are then washed out of the rectum

INJECTION OF HÆMORRHOIDS

A sclerosing agent such as 5 per cent carbolic acid in almond oil is injected through a proctoscope into the submucous space just above the hæmorrhoid From 2 to 10 ml are injected on three or four occasions No preparation or special attention is required beforehand or afterwards although sometimes the injection is followed by some discomfort in the anal region for a few hours This should be treated by rest and aspirin

These injections cause a reaction around the veins passing upwards from the hæmorrhoids and this reaction in turn leads to stasis and thrombosis in these veins As a result, thrombosis and fibrosis occur in the hæmorrhoids

the anus and a bowl of swabs should be at hand in case the anus requires cleansing

Hot water soap and a clean towel should be in readiness for the surgeon to cleanse his hands at the conclusion of the examination

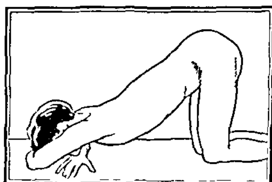


FIG 257 Knee chest position for rectal examination

INCONTINENCE OF FÆCES

Incontinence of fæces is the involuntary discharge of fæces due to loss of control over the sphincter muscles of the anus It occurs more frequently in women than in men

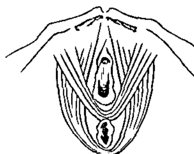


FIG 258 Diagram (after Thompson) of the muscles of the pelvis floor from below showing the muscular slings arising from the pubic bones and passing behind the vagina and behind the rectum

The posterior muscular sling provides the chief sphincter mechanism for the rectum it pulls the anorectal junction forwards and it is known as the puborectalis part of the levator ani muscle

There are two forms of fæcal incontinence

TRUE INCONTINENCE occurs when the rectum is cut off from its cerebral control by a lesion either of the spinal cord or of the nerves running from the lumbar spinal cord to the rectum It also occurs when the anal sphincter muscles are destroyed by operations on or diseases of the lower end of the rectum There are two types of true fæcal incontinence —

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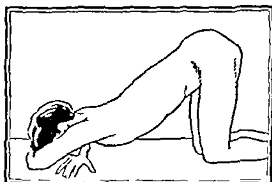


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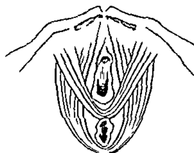


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REMOVAL OF HÆMORRHOIDS

Preparation Operations on the rectum are carried out in the presence of many organisms but with wounds which allow free drainage and which are properly cared for afterwards there is little risk of septic infection

As mentioned below phthalyl sulphathiazole (sulphathalidine) aureomycin streptomycin, etc, when taken by mouth in sufficient doses, will kill most of the organisms in the lumen of the bowel However such preparation does not sterilize the fæces and will not prevent some contamination of a perianal wound If contamination does occur and such a wound is closed then the organisms may multiply and give rise to an abscess or fistula Since few patients wish to take this risk most surgeons leave the wounds open after rectal and anal operations

The injection of penicillin has very little effect in preventing or controlling infections of wounds with organisms belonging to the group of Gram negative organisms for most of these are relatively insensitive to penicillin It is also because of this lack of sensitivity that penicillin is not effective in stopping the development of perianal and ischiorectal abscesses

It is no longer considered essential to wash out the bowel for days before a rectal operation Indeed if there is any painful lesion (abscess, fissure etc) bowel wash outs and enemata may be omitted Usually an enema the evening before operation is sufficient It is not advisable to give an enema or wash out the day of operation since all the fluid may not be expelled from the rectum and it would then be a nuisance during the operation If it is believed that the enema fluid of the previous day has not been completely expelled, a rectal tube should be passed before taking the patient to the theatre Aperients are better avoided in the preparation of patients for operation because of the difficulty in controlling the time at which the bowels will act

In the twenty four hours before operation one or more doses of mist catechu et opii should be given if the patient is suffering from diarrhœa

On the evening before operation the parts about the anus should be shaved and well washed

Operation The lithotomy position is favoured by most surgeons but the left lateral position and the prone position are also satisfactory The Buie position is used by relatively few surgeons (Fig 67c)

For the preparation of the skin a weak solution of Dettol Zephiran or Cetavlon is sufficient Strong antiseptics will do more harm than good when applied to the rectal mucosa

During the operation the surgeon will usually dissect out the three hæmorrhoids tie them off with a strong ligature and then remove the portions below the ligatures Hæmostasis is obtained by ligating

each bleeding point The three wounds should then be flat with no overhanging edges under which infection may develop The fibres of the anal sphincter muscles should not be included in the ligatures as this will greatly increase the pain after operation

At the end of the operation a small rubber tube may be inserted into the anus to hold the dressing in place, but it is better avoided as its presence will increase the pain If a tube is used, it should be removed twelve to twenty four hours later In the past it was the practice to insert a large tube in all cases in the hope of providing a passage for flatus and perhaps also for blood However, the openings in the tube quickly became blocked by the rectal mucosa and even if there is any bleeding and blood enters the tube, it will almost certainly clot and block the lumen

Vaseline gauze dressings and other greasy dressings are often used at the end of these operations, but gauze kept moist with eusol or Milton is advocated at St Mark's Hospital London and it is no more likely to adhere to the wound Eusol and Milton have an antibacterial effect which is lacking with Vaseline etc Gauze squares about two inches in diameter are used The corner of one or more gauzes is inserted into the anus to keep the wounds flat and separated Ribbon gauze should not be used as its edges have a tendency to roll together

After the dressings have been applied they are covered with a cotton wool pad and kept in place with a T bandage

After-care PAIN The relief of pain is of prime importance It is best obtained by the required dosage of pethidine hydrochloride tablets orally (50 to 100 mg t d s for four to six days whether or not the patient is complaining of pain) together with the use of morphine hydrochloride (gr $\frac{1}{6}$ to $\frac{1}{4}$) pethidine hydrochloride (50 to 100 mg), or Omnopon (gr $\frac{1}{3}$ to $\frac{1}{2}$) by injection whenever the pain is severe A large dose, such as morphine hydrochloride gr $\frac{1}{4}$ should be given prior to the first dressing In these doses there is little risk of habituation or drug addiction If used with care a hot water bottle may help to relieve the pain in the first few days

DIET For the first five or six days after operation a light diet is given and then it is gradually increased to normal It is not necessary to restrict the diet before operation

BOWELS The bowels usually do not act for four to six days Liquid paraffin (half an ounce t d s) is commenced on the day after operation and a teaspoon of the elixir of cascara sagrada is given on the fourth night and each night thereafter till the bowels act The liquid paraffin is then gradually reduced as required

DRESSINGS The wound is cleansed and the dressing is changed at least once daily after the third day but, in addition it is changed and the wound irrigated each time the bowels act Irrigations of the

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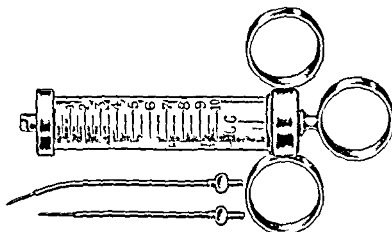


FIG 260 Gabriel's syringe for injection of the submucous space of the anal canal with 5 per cent phenol (carbolic acid) in almond oil
The injection of up to 10 ml is made just above the hæmorrhoid

couraged to try to pass urine naturally Often the retention will be relieved by an injection such as morphia Warm fomentations should be applied over the bladder and if this fails the patient may be permitted to turn on his hands and knees or to stand up to attempt micturition Sixteen grains of potassium acetate in half an ounce of water every

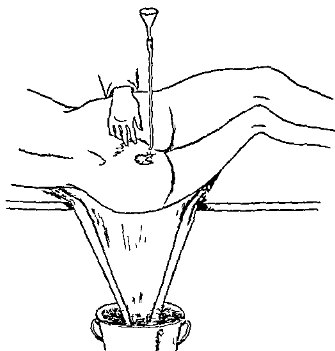


FIG 261 The position of a patient for irrigation of a perianal wound
The fluid is run on to the wound from a catheter and funnel and drains away via a mackintosh into a bucket

wound are best carried out under vision as it is then possible to ascertain that the discharge and fæces are all removed Red lotion (Lotio rubra) is used on the gauze instead of the eusol or Milton after eight to ten days If the wound heals slowly IB paint may be occasionally applied

Irrigations are carried out with the patient on the left side with the buttocks over the edge of the bed and with a rubber sheet under the buttocks and leading to a bucket on the floor The irrigating fluid (Normal saline or half strength eusol or Milton) is run over the wound from a funnel and about two feet of tubing (Fig 261)

CONVALESCENCE Healing of the wounds will be delayed if the patient is allowed up during the first week It is the usual practice to confine the patient to bed for ten days After that his activities are usually limited for a further ten days

Complications RETENTION OF URINE For the first few days after a rectal operation this is a very common trouble and one for which the nurse must always be on the alert The patient should be en

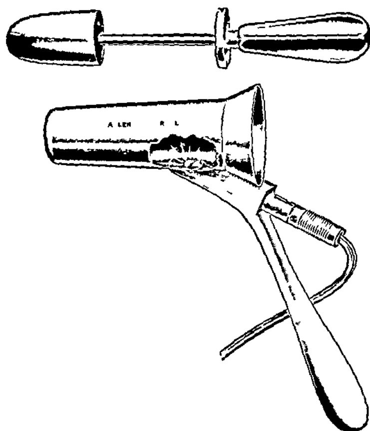


FIG 259 Naunton Morgan s rectal speculum (proctoscope) a portion of which has been cut away to show the light

internal and it is well to remember that the amount of external hæmorrhage is no criterion as to the total amount of hæmorrhage, as the rectum and sigmoid may be filled with blood

If the bleeding is from external wounds it may be controlled by removing the eusol gauze and applying firm pressure over Oxycel gauze or other hæmostatic agent

In women the hæmorrhage may be temporarily controlled by passing a finger into the vagina and compressing the rectum against the sacrum

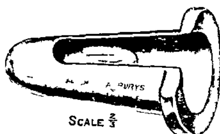


FIG 264 Lockhart Mummery's rectal speculum This is used to examine *the wall of the anal canal*

If severe hæmorrhage occurs an anæsthetic should be administered, the bowel should be emptied of blood clot, and any bleeding point seized with forceps and ligated or oversewn

Occasionally, an attempt may be made to control the bleeding by

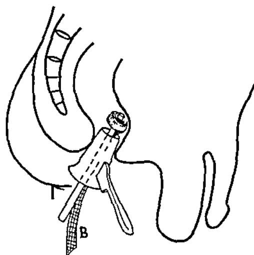


FIG 265 A diagram of a section through the midline of the pelvis showing a tube and surrounding gauze in the anus

After removal of the proctoscope the tube and gauze (*B*) are pulled downwards to exert pressure on the bleeding area

plugging the rectum with a 'petticoated' tube or with a tube and surround (Fig 265)

The Petticoated Tube This consists of a strong square of sterile

half hour up to eight doses sometimes helps So also may 0 25 mg of carbachol If a catheter has to be passed, a soft Jaques' catheter should be used, and, of course, this should be passed with full aseptic precautions

HÆMORRHAGE After removal of hæmorrhoids hæmorrhage may supervene but fortunately this is rare

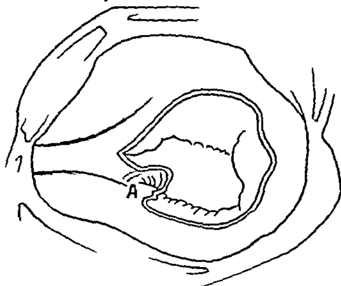


FIG 262 Diagram of a wound in the ischiorectal fossa after excision of an extensive anal fistula

The drawing has been made with the patient on the left side and with the wound surrounded by drapes This wound is shallow its walls are sloping and there are no cavities or recesses formed by overlapping edges *A* The anus

The hæmorrhage may be *Primary* or *Reactionary* when it occurs a few hours after the operation and is due to slipping of a ligature or *Secondary* which takes place about the sixth day, and is due to



FIG 263 Diagram of the wound after excision of a posterior anal fissure

The cut ends of the subcutaneous portion of the anal sphincter muscle are just visible Again like the wound in the previous diagram this wound is flat with no overhanging edge

the separation of a sloughing pile or to the cutting out of a ligature Both forms require active treatment for the bleeding is often free and just as often accompanied by a considerable degree of collapse

Even if a tube is placed in the rectum the bleeding is generally

that is there is no great depth to the wound and no cavity to pack The dressings of gauze squares are laid flat on the surface of the wound

At the end of the operation a large pad of cotton wool is applied to the anal region and is retained in position by means of a T bandage

After treatment DRESSINGS As regards the prospect of ultimate recovery the dressing of a fistula is as important as the operation itself

The external pads are changed daily but the internal dressing of gauze squares is kept moist with eusol or Milton and is undisturbed for three days Thereafter the wound is irrigated with Normal saline or half strength eusol or Milton, and the dressing is changed daily and after defæcation The dressings are kept moist with eusol or Milton for the first week or two, and then with red lotion

If a deep cavity has been produced by the operation and it is requested by the surgeon that the cavity be packed from below upwards", great care is necessary to pack the depths of the wound so that healing will really be from below upwards Because of the pain produced, such packing may be difficult or impossible Whenever there is a deep cavity and it is incorrectly or inadequately packed a portion of the wound may heal over and leave a pocket of infection in its depths This will lead to an abscess or to another fistula

In the exceptional cases where the surgeon has been unable to avoid leaving a cavity to be packed the pain may be lessened by inserting a finger lubricated with KY jelly into the rectum to act as a guide The dressing of wool or gauze is carried up along the whole length of the wound by means of a sterile glass rod or director which is passed up alongside the finger the glass rod is then gently with drawn and the dressing left *in situ*

It is to be remembered that any pressure on the wound not only gives great pain but also retards healing and hence plugging the wound by stuffing it full of gauze should be avoided

BOWELS For the first five days or so the bowels are kept confined, after which a daily loose action should be secured by means of any laxative which the patient prefers

DIET The diet should be restricted until the bowels are open

CONVALESCENCE In the milder cases complete healing may be expected in about three weeks but in the severer cases it may be delayed for more than eight weeks The patient should not be allowed to walk about until the wound has healed for walking and standing are apt to retard healing

TUBERCULOSIS A few cases of anal fistula are tuberculous in origin and in addition to the operative treatment and after care required for non tuberculous fistulæ they also require treatment of the tuberculosis

linen, in the centre of which is a small hole To the margins of this hole a stout tube is firmly fixed by a silk thread so that the apparatus looks like a closed umbrella The end of the tube is introduced into the bowel for about three inches, and strips of gauze or cotton wool are packed between the tube and the linen square until a sufficient plug is obtained to control the hæmorrhage

The plug should be left *in situ* for two days and morphia given to relieve the discomfort

Tube and Surround A similar but more effective method of con trolling the bleeding is by the use of a rubber tube around one end of which ribbon gauze has been wound till it will all just pass through a proctoscope Oxycel gauze may be fixed on the outside of this ribbon gauze After passing the proctoscope into the rectum the tube and its gauze are inserted through it and then the proctoscope is withdrawn Mild traction on the tube will bring pressure from the gauze down on to the bleeding spot

ULCERATION ABSCESSES FISTULÆ, ETC, may follow operations for the removal of hæmorrhoids

Infection of the wound should be treated as infected wounds else where but it must be remembered that piles are varicosities of the tributaries of one of the trunks of the portal vein, and that a septic phlebitis in this situation is extremely serious Hence a severe pyrexia rigor or abdominal pain associated with symptoms of infection occurring some days after hæmorrhoidectomy should at once be reported to the surgeon

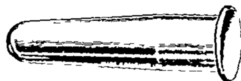


FIG 266 St Mark s Hospital rectal dilator which is available in two sizes

STRICTURE OF THE RECTUM After hæmorrhoidectomy the raw surfaces left may fuse or the contraction of these areas as they heal may lead to some narrowing in the anal canal The surgeon should examine the bowel with the finger about the tenth day and if any tendency to constriction is found the scar must be stretched regularly

FISTULA IN ANO

The preparatory treatment and the position of the patient at operation are the same as those already given for hæmorrhoids

Rarely the surgeon may close the wound and hope to obtain primary healing but this is likely to be unsuccessful and then it is followed by the development of a new fistula Accordingly, the wound is usually left open This wound may be small or large but it should be shallow with flat sloping sides It is then said to be saucerized

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The external pads are changed daily but the internal dressing of gauze squares is kept moist with eusol or Milton and is undisturbed for three days Thereafter the wound is irrigated with Normal saline or half strength eusol or Milton, and the dressing is changed daily and after defæcation The dressings are kept moist with eusol or Milton for the first week or two, and then with red lotion

If a deep cavity has been produced by the operation and it is requested by the surgeon that the cavity be packed from below upwards, great care is necessary to pack the depths of the wound so that healing will really be from below upwards Because of the pain produced, such packing may be difficult or impossible Whenever there is a deep cavity and it is incorrectly or inadequately packed a portion of the wound may heal over and leave a pocket of infection in its depths This will lead to an abscess or to another fistula

In the exceptional cases where the surgeon has been unable to avoid leaving a cavity to be packed the pain may be lessened by inserting a finger lubricated with KY jelly into the rectum to act as a guide The dressing of wool or gauze is carried up along the whole length of the wound by means of a sterile glass rod or director which is passed up alongside the finger the glass rod is then gently withdrawn and the dressing left *in situ*

It is to be remembered that any pressure on the wound not only gives great pain but also retards healing and hence plugging the wound by stuffing it full of gauze should be avoided

BOWELS For the first five days or so the bowels are kept confined after which a daily loose action should be secured by means of any laxative which the patient prefers

DIET The diet should be restricted until the bowels are open

CONVALESCENCE In the milder cases complete healing may be expected in about three weeks but in the severer cases it may be delayed for more than eight weeks The patient should not be allowed to walk about until the wound has healed for walking and standing are apt to retard healing

TUBERCULOSIS A few cases of anal fistula are tuberculous in origin and in addition to the operative treatment and after care required for non tuberculous fistulæ, they also require treatment of the tuberculosis

Complications FORMATION OF FRESH SINUSES may be suspected if the patient complains of fresh pain in the region of the wound or if there is any increase in the discharge from the wound

FOR OTHER COMPLICATIONS see the paragraphs on complications following the removal of hæmorrhoids

ANAL FISSURE

The preparatory treatment and the position of the patient during operation are identical with those employed for the removal of hæmorrhoids After the ulcer has been excised a gauze square is placed in the wound The subsequent after treatment is similar to that employed for fistulæ

RECTAL POLYP

At operation a ligature is applied around the base of the polyp which is then removed The preparation and after-care for this operation are much the same as for hæmorrhoidectomy

RECTAL PROLAPSE

A large number of different operations is used for the treatment of rectal prolapse These include methods to narrow the anus to excise the prolapsed bowel and to fix the rectum to various pelvic structures, but none of them is 100 per cent successful

The pre and post operative treatment for these operations is much the same as that of other rectal and anal operations

EXCISION OF THE RECTUM

This operation is most often performed for the removal of a cancer of the anus or rectum

Preparatory Treatment The local preparation for operation where a resection of the large intestine or rectum is contemplated should aim at two objects —Firstly, the large bowel will be as nearly as possible empty at the time of operation and secondly, as far as possible its contents will be rendered aseptic

A saline laxative is used for a few days prior to the operation to liquefy the fæces and to empty the bowel A bowel wash out is given on each of the two evenings before the operation On the day of the operation a rectal tube is passed to ensure that no fluid is left in the rectum

The general treatment before excision of the rectum consists in improving any deficiencies of hæmoglobin (by transfusion of packed cells), of vitamins (by injections especially vitamins B_1 C and K) of protein (by a high caloric high protein attractive diet) and of electro lytes such as those of sodium and potassium (by oral route) There will usually be little time for the complete correction of these various deficiencies as it is essential to proceed with the ope n in order to

prevent the spread of metastases and to arrest the deterioration in the general condition Thus, the general condition of the patient is improved as far as possible in the time allotted, and then, having regard to the present state of health, the size position and fixation of the growth, the appropriate type of operation is chosen

The methods of excision of the rectum now favoured are —

(i) the abdomino perineal operation of Miles,

(ii) the synchronous combined method with two surgeons working simultaneously,

(iii) the perineo abdominal operation of Gabriel

(iv) anterior resection,

(v) the perineal excision of Lockhart Mummery, and

(vi) Hartmann's operation

Normally, many of the organisms in the fæces are dead but the number of live organisms can be decreased still further by the oral administration of phthalyl sulphathiazole (Thalazole) streptomycin, aureomycin Neomycin etc As a result of such treatment, when an opening is made into the bowel very few live organisms will be spilled to contaminate the surrounding tissues The few organisms that are still alive when liberated from the bowel will usually soon be overcome by the normal process of defence of the body which might not have dealt successfully with millions of live organisms Thus unless visible pieces of fæces are allowed to remain in the wound it is now possible to open the bowel and still obtain first intention healing of the wound that is healing without apparent infection

For bowel antisepsis a typical dosage of phthalyl sulphathiazole is 2 to 3 grammes every six hours for four days

Streptomycin is given *orally* in a dosage of 0 5 gramme t d s for this purpose for the same length of time

Aureomycin is given in capsules in a dosage such as two capsules (250 mg each) t d s for three days and Neomycin may be given with success for even shorter periods

After operation these drugs are stopped unless an anastomosis of the bowel has been performed and in that case they may be continued for another three or four days As the bowel is not divided until the end of the perineo abdominal excision and of the synchronous combined excision, preparation with these insoluble sulphonamides and antibiotics is not so important but even then they are still advisable lest the bowel is opened inadvertently during the operation

On no account should the patient be purged on the day prior to operation nor is there any need in these cases for starvation on the evening of that particular day

Before starting the operation a Foley catheter is passed into the urinary bladder and then the bladder is completely emptied by pressing

on the suprapubic region The catheter is left *in situ* during the operation and for seven days afterwards

The balloon of the Foley catheter is not blown up until the end of the operation otherwise it forms a mass in the bladder which may be inconvenient for the surgeon

Abdomino-perineal Excision In the first stage of this operation during which the surgeon frees the rectum down to the pelvic diaphragm, the high Trendelenburg position is adopted Prior to closing the laparotomy wound a left iliac colostomy is performed

For the second stage of the operation the patient is placed in the left lateral or exaggerated lithotomy position with the pelvis well raised and the thighs flexed The rectum and colon below the colostomy are then removed

A few surgeons favour the prone inverted V position of Buie with *the head and feet low and the buttocks uppermost*

In women in addition to preparation of the skin over the sacrum and perineum the vagina should be swabbed out with an antiseptic such as a weak solution of Dettol

Perineo-abdominal Excision This overcomes the difficulty of closing the pelvic peritoneum over the mass of bowel and growth that occurs during Miles' abdomino perineal procedure and, also the bowel is not divided until the abdominal wound is closed Thus there is less risk of peritoneal contamination

Synchronous Combined Excision of the Rectum For this operation the patient is placed in a combined lithotomy and Trendelenburg position in the special stirrups described by Lloyd Davies The abdominal surgeon commences the operation and as soon as he determines that it is possible to remove the growth the perineal surgeon commences The bowel is freed from below upwards and is passed out through the abdominal wound This also overcomes the difficulty of closing the pelvic floor over the bowel that is met with half way through the classical abdomino perineal operation and *also the bowel is not divided till all wounds are closed Another* advantage is that with two surgeons working together it is sometimes possible to remove a growth which would be irremovable when attempted by one surgeon working alone

Perineal Excision of the Rectum This operation is performed when the growth is low in the rectum and the patient s general condition is poor It consists of two stages the first being the construction of a loop colostomy in the left iliac fossa and the second the removal of the rectum and anal canal through the perineum Where the upper end of the rectum is divided the cut end is oversewn The resulting perineal wound is managed in a similar manner to the wound following an abdomino perineal excision

Hartmann's Operation This operation is the o osite of the

perineal excision It is used when the growth is high in the rectum and the patient s general condition is poor It resembles the upper half of an abdomino perineal operation After mobilizing the rectum as far as possible through the abdomen the bowel is divided below the growth The upper end of the rectal stump is oversewn the pelvic peritoneum is closed and the upper end of the sigmoid colon is divided The portion of the bowel containing the growth is removed and the cut end of the sigmoid colon is brought out as an end ' colostomy

Anterior Resection of the Rectum When the growth is in the upper portion of the rectum and when the patient's general condition is good it is sometimes possible, after removing the same amount of bowel as in the Hartmann operation, to proceed to anastomose the cut end of the sigmoid colon to the rectal stump in the depths of the pelvis This is often difficult to perform but when successful it avoids the need for a colostomy It is usual to insert a drain tube down to the site of the anastomosis, for this anastomosis is more likely to leak for a few days after the operation than is an anastomosis further up in the colon

After treatment POSITION Once the patient has regained consciousness he should be placed in the semi sitting position

DIET As soon as the feeling of nausea has passed off small quantities of liquid food may be ordered at two hourly intervals After the colostomy has acted the diet may be increased

For the first forty eight hours an intravenous infusion of dextrose in N/5 saline is usually given in sufficient amounts to allow the passage of at least 25 to 30 ounces of urine per day

BOWELS Some surgeons prefer to paint the wound with a protective solution such as tinct benz co , to seal off the tissue planes and to open the colostomy without the use of a Paul s tube In any case the colostomy will only act in the first few days if there has been some degree of obstruction due to the growth Olive oil may be run into the colostomy to help it act but this is usually unnecessary After four to six days a small dose of a mild aperient may be given and most times this is all that is required

On the tenth day the colostomy is trimmed if necessary any excess bowel being excised close to the skin surface A gloved finger may be passed into the colostomy monthly to ensure that there is no cicatricial contraction of the opening

PERINEAL WOUND As the walls of the cavity cannot be brought into apposition the extensive perineal wound left after removal of the rectum has to heal by granulation

After the first twenty four hours the external dressings are changed twice daily

In many cases the skin and subcutaneous tissues of the perineal wound will be completely closed with sutures except for a tube at its

anterior end (Fig 268) In such cases the tube is removed on the third day After that the perineal wound may be irrigated daily with Normal saline, half strength eusol, or 1 in 1,000 acriflavine

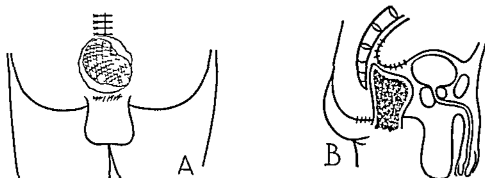


Fig 267 Diagrams showing a gauze pack and a layer of waterproof material inserted into the pelvic cavity after an abdominoperineal excision of the rectum

A Back view The skin of the natal cleft may be sutured for a short distance behind the pack *B* The sutures shown above the pack are in the peritoneum of the pelvic floor

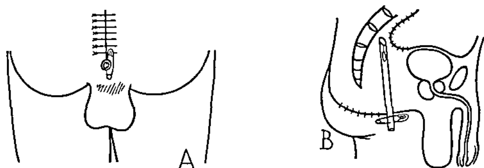


Fig 268 Diagrams showing a tube in the pelvic cavity after an abdominoperineal excision of the rectum

A Back view The skin of the natal cleft is closed behind the tube with sutures *B* Sagittal section

If the wound has been left open and packed the packing is not removed for 48 hours

The wound should be healed in three or four weeks When there is little discharge from the wound irrigation of it may be omitted

Abdominal Wound The abdominal wound is dealt with in the usual manner

Duration of Rest in Bed After two days the sitting posture is adopted and the patient is allowed out of bed in one week The upright position causes the peritoneum to sink into the pelvis and so diminishes the depth of the perineal wound

Healing and convalescence after removal of the rectum are sometimes

prolonged and tedious Care should be taken to maintain the patient's hopes and interests

Complications SHOCK is an important cause of post operative death, but it may be combated by the previous preparation of the patient and by blood transfusion The latter is followed by continuous intravenous infusion with dextrose in N/5 saline for the first twenty four hours or more The bed may be electrically heated, but overheating is dangerous

HÆMORRHAGE Hæmorrhage is rarely difficult to deal with and is usually treated by packing

RETENTION OF URINE Injury to the hypogastric plexus and presacral nerve is an almost inevitable result of excision of the rectum, hence post operative retention of urine is very prone to occur Stasis in the bladder is also likely as some of the support to its posterior wall is removed

The time during which retention persists varies directly with the degree of nerve damage In the less severe cases the patient may require to be catheterized every eight hours for the first few days but most surgeons prefer to use an indwelling catheter as long as there is more than 50 ml of retained urine in the bladder

With the object of preventing infection of the genito urinary tract Dukes devised a special apparatus for use with an indwelling catheter (Fig 269)

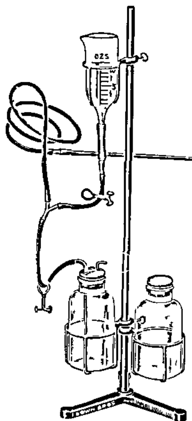


FIG 269 Dukes bladder irrigator

The indwelling catheter is introduced and the bladder is emptied every four hours The upper clip is then also released for a few seconds to wash the urine out of the tubing If desired antiseptic fluid may be run into the bladder by releasing the upper clip and closing the lower one

By temporarily opening both bottle and catheter clips the retained urine is evacuated then by similar relaxation of funnel and bottle clips the tubing is washed through with antiseptic fluid (1 in 5 000 oxycyanide of mercury solution) and when it is full both clips are closed To irrigate the bladder release the funnel and catheter clips until the patient begins to feel discomfort when the procedure related above for emptying the bladder is repeated The Y shaped junction must be securely fixed so that it does not drag on the indwelling catheter

INTESTINAL OBSTRUCTION In most of these cases a loop of small intestine either has slipped through an aperture in, or has become adherent to, the suture line of the new pelvic floor Less often it has become adherent to the side of the colostomy loop

The signs of acute intestinal obstruction will be present, and the condition will necessitate immediate operation for its relief

LUNG COMPLICATIONS are rather frequent after excision of the rectum, and appropriate prophylactic measures must be taken

Reference

Edward Wilson The Post Operative Management of Peri Anal Wounds, *The Australian Nurses Journal*, June 1952 Volume L, page 119

CHAPTER 27

GYNÆCOLOGICAL OPERATIONS

VAGINAL EXAMINATION

If the vagina is to be examined, the following should be ready —

A rubber glove

A receiver with a few swabs

KY jelly, Vaseline or other lubricant

The nurse should always be present when a vaginal examination is being made The patient is placed in the left lateral (Sims) or the dorsal position, according to the practice of the surgeon, and the clothes are so arranged that there is free access not only to the vulva but also to the anterior abdominal wall

Soap and a clean towel should be in readiness for the surgeon at the conclusion of the examination

PESSARIES

In some cases a pessary is inserted well up in the vagina to hold the uterus and vaginal wall in its correct position A pessary is usually a complete ring made of rubber, but vulcanite and perspex are also used The latter are of course rigid and may be circular or a bent oval in shape (Hodge s pessary, Fig 271)

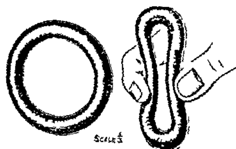


FIG 270 Watch spring pessary covered with rubber in 15 sizes from 2 inches to 3½ inches in diameter



FIG 271 Hodge s pessary in 6 sizes from 2¼ inches to 3¾ inches long

For the rubber pessaries a special introducer may be used

As the presence of a pessary predisposes to infection it should be cleansed frequently and vaginal douches will probably be required

VAGINAL TAMPONS

Tampons are used to treat inflammatory conditions of the vagina and pelvic organs or as a means of controlling bleeding They are made of absorbent cotton wool or gauze

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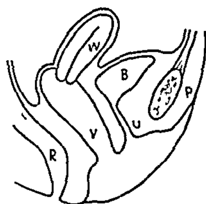


Fig 272 Sagittal section of the normal position of the female pelvic viscera *B* Bladder *P* Pubic symphysis *R* Rectum *U* Urethra *V* Vagina, and *W* Womb or uterus

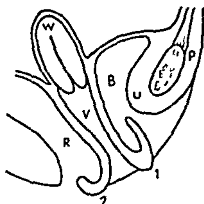


Fig 273 Sagittal section of the female pelvic viscera showing (1) a cystocœle and (2) a rectocœle See Fig 272

and this is removed at the end of thirty six or forty eight hours The vagina must then be kept as clean and aseptic as possible the vulva should be cleansed daily with some mild antiseptic solution, and the vulval pad changed twice or thrice daily Only if the vaginal discharge becomes offensive will a vaginal douche be ordered, but care must then be taken that it is given with very little pressure

During the first few days the quantity of urine passed by the patient should be measured and recorded

If the abdominal wall is weak, the surgeon may advise a well fitting abdominal belt

Special Complications The post operative complications following abdominal operations on the generative organs are similar to those described in Chapter 23 and are treated in the same way

Internal Hæmorrhage After all gynæcological operations a sharp look out must be kept for the signs of internal hæmorrhage, for should this be severe the wound must be opened up and the bleeding point secured

Shock After hysterectomy shock may occur and should be treated by the usual methods

Sepsis Sepsis may manifest itself in three ways —(a) pelvic cellulitis (b) local peritonitis and (c) suppuration of the abdominal wound Its treatment consists of the use of antibiotics and the establishment of free drainage

Retention of Urine This frequently occurs after pelvic operations, and catheterization will be adopted if other measures fail to produce relief

A catheter should be passed every six to eight hours, and the fullest aseptic precautions must be observed in order to avoid setting up a cystitis

A tampon should be inserted only when the bladder and bowels are empty, and when clots or secretion have been removed from the vagina The tampon is introduced with full aseptic precautions, a Sims speculum and a dressing forceps being used A second wool tampon is then inserted to retain the first in position, and whilst the tampons are being pressed upwards with the forceps the speculum is removed

The strings attached to the tampons are left hanging from the vagina, and by means of these the tampons are removed within twenty four hours, when a cleansing douche is administered

Operations by the Abdominal Route

The commoner operations are —

Hysterectomy or Removal of the Uterus This may be (a) Sub total removal of the body alone, (b) Total where both body and cervix are removed and (c) Pan hysterectomy where the whole uterus, together with the tubes and ovaries, is removed

Internal Shortening of the Round Ligaments This operation is performed to correct a backward displacement of a uterus

Salpingectomy, or removal of a uterine tube

Oophorectomy, or removal of an ovary

Preparation for Operation Operations on the female pelvis by the abdominal route call for the same general and local preparations as have already been described in Chapter 23 In order to empty the bladder, so that it may be retracted away from the operation site, a catheter should be passed immediately prior to operation

Before any operation which will open up both the abdominal cavity and the vagina, *e g* total hysterectomy the vagina should be thoroughly cleansed and prepared in a manner similar to that described under Vaginal Operations

Position at Operation These operations are usually carried out with the patient in the Trendelenburg position She is therefore placed on the operating table with the knees at the level of the foot piece of the table This is then dropped the shoulder supports are moved into place and the bottom end of the table is raised until the required position is attained

After treatment This differs very little from that described already for abdominal operations in general

The patient is kept in bed a couple of days and leaves the hospital about the twelfth day

The bowels should be opened about the fourth day but if flatulent distension occurs causing pain an enema may be given before that time

No douches are given after abdominal section as a rule After a total hysterectomy, a gauze drain may be inserted into the

After defæcation and micturition the cleansing of the parts is repeated and a fresh pad is applied

For shaving the external genitalia a safety razor is usually much quicker, safer and easier to use than the ordinary razor

VAGINA In order to render the vagina aseptic the patient should be douched twice daily as long as possible before the operation The douches usually used include potassium permanganate (1 in 1 000), Dettol (1 in 200), liquor iodi mitis (half a drachm to the pint) and Normal saline These should be given at a temperature of 110° Fahr The apparatus should be rendered sterile by boiling preparatory to administering the douche

THE BOWELS should be well opened by aperients for several days before operation, but no aperient should be given within thirty six hours of the operation An enema should be given about 8 p m on the night before operation If the bowels are not thoroughly emptied beforehand, there may be an evacuation during the course of the operation, and this may lead to infection of the wound

URINE Immediately prior to vaginal operations it is also advisable to empty the bladder thoroughly by catheterization

A vaginal operation should be avoided during a menstrual period unless postponement is considered to be dangerous

Position at Operation Vaginal operations are performed with the patient in the lithotomy position with the legs encased in sterilized linen bags or towels which are brought together over the pubes so as to leave a satisfactory exposure of the perineum

A mackintosh or Kelly s pad is placed under the patient s buttocks so as to convey all fluids into a pail placed at the foot of the table, and the toilet of the vulva and vagina is repeated using Dettol (1 in 200) and gauze sponges on sponge holders

A sterile towel is placed transversely across the abdomen and another across the perineum They are fastened to the skin of the buttocks or to the leg holders on either side

After treatment POSITION The patient is returned to bed and placed in the dorsal or lateral position according to the practice of the surgeon

DRESSING After curettage colporrhaphy and repair of the cervix uteri etc some ribbon gauze about 1½ inches broad and three or more feet long is sometimes placed with one end inside the uterus and the remainder used to pack the vagina If two pieces are used, they are tied together The gauze is all in one piece so that on its removal there is no likelihood that any part will be left behind in the uterus or vagina The gauze is generally removed at the end of twenty four to forty eight hours and the vagina douched very gently

After perineorrhaphy the wound is usually protected by a sterilized strip of gauze covered by a sterilized gauze pad which is held in

If repeated catheterization has been necessary and the patient is able to pass urine again, a catheter should be passed once daily until no residual urine is found If there is any evidence of cystitis 15 ml of 10 per cent Argyrol should be instilled into the bladder after this daily catheterization

INJURIES TO THE BLADDER URETER OR RECTUM may occur during hysterectomy and subsequently lead to urinary or rectovaginal fistula

OPERATION BY THE VAGINAL ROUTE

Types of Operation CURETTAGE Removal of the mucous lining of the uterus polypi or placental debris by scraping

REPAIR OF THE UTERINE CERVIX

COLPOTOMY Opening into the peritoneal cavity through the vault of the vagina usually for drainage of a pelvic abscess

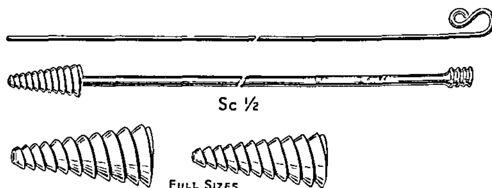


FIG 274 Leech Wilkinson s cannula for transuterine insufflation and salpingography for testing the patency of the uterine (Fallopian) tubes in cases of sterility

VAGINAL HYSTERECTOMY Removal of the whole of the uterus through the vagina At the same time the tubes and/or ovaries may be removed

ANTERIOR COLPORRHAPHY Replacement of a prolapse of the urinary bladder and anterior vaginal wall (cystocœle) (Fig 273)

POSTERIOR COLPORRHAPHY Replacement of a bulging of the rectum and the posterior vaginal wall (rectocœle)

PERINEORRAPHY Repair or reconstruction of the perineum

SALPINGOGRAPHY A radio opaque oil is injected through the cervix into the uterus and uterine tubes X ray examination will then show whether or not the uterine tubes are patent This is used as a test (Rubin s test) in the investigation of the cause of sterility

Preparation for Operation SKIN On the night before operation the vulva is shaved and cleansed in a manner similar to that described for operations in general and it is then covered with a sterile pad kept in place by a T bandage

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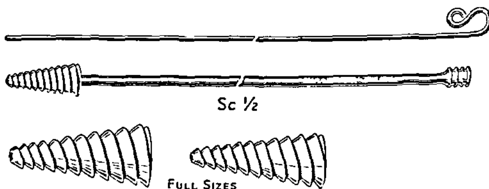


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URINE If the patient is unable to void urine, she must be catheterized every six to eight hours

If the urine is passed spontaneously, the wound and dressings will be soiled the wound should then be swabbed with weak antiseptic solution carefully dried and a fresh dressing applied

Until the patient can void urine normally, urinary antiseptics and plenty of fluids by mouth are indicated

Special Complications

After Curettage of the Uterus, etc. RETENTION OF URINE This occasionally occurs, especially after the vagina has been even lightly packed with gauze but before resorting to catheterization it is advisable to remove the plugging and to sit the patient up

HÆMORRHAGE After curettage this is quite rare If it does occur it should be treated by vaginal plugging or by hot douching at a temperature of 120° Fahr but, after repair of the cervix uteri other measures may be necessary

After Perineorrhaphy HÆMORRHAGE If a hæmatoma forms in the wound the blood should be allowed to escape, as its presence interferes with healing

SEPSIS Infection is the chief complication for if severe it interferes with the success of the operation and the wound tends to break down Prevention of sepsis almost entirely depends upon the thoroughness of the after treatment

If the entire wound is infected the superficial sutures should be removed drainage established, and later an attempt made to obtain union by granulation On the other hand if infection is limited only the sutures involved should be removed at once

RETENTION OF URINE commonly occurs, but is not important as a catheter is usually passed as a routine

VAGINAL ADHESIONS After vaginal operations and prior to their being discharged home all patients should be examined per vaginam so that any vaginal adhesions may be broken down while they are still soft

Special After treatment of Vaginal Hysterectomy DRESSING As a rule the vaginal vault is lightly packed with gauze and the remainder of the gauze loosely inserted into the vagina This is usually removed on the third or fourth day after which the only attention required will be carefully to swab out the lower end of the vagina with a weak antiseptic solution This is repeated about every six hours

URINE Until the gauze is removed from the vagina a catheter should be passed every eight hours

HÆMORRHAGE may occur from the stumps of the broad ligaments, and if it is free the surgeon should be informed at once

position by a T bandage, but in addition some surgeons loosely fill the vagina with sterile gauze which will be removed on the fourth day

On account of its position great difficulty is experienced in keeping the wound aseptic, and hence the successful termination of the case practically resolves itself into *a question of efficient nursing*

The wound must be redressed whenever it is soiled by urine fæces vaginal discharge etc but in those cases where the urine is withdrawn by catheterization it should not be necessary to dress it more than twice daily until the bowels commence to act

On removing the dressing the wound both in the perineum and vagina is gently swabbed with Monacrin (1 in 1,000) carefully dried, and a fresh dressing applied A narrow strip of ribbon gauze soaked in 1 in 1 000 acriflavine in paraffin constitutes a simple and efficient dressing If the wound becomes infected it may break down and healing will then be by granulation

DOUCHING Douching except on removal of gauze is not ordered as a rule but if there is any offensive discharge the vagina should be douched once or twice daily However, there is a tendency to replace douches in these cases by the intravaginal injections of antiseptic jellies

SUTURES Any cutaneous sutures may be removed on the eighth day but sutures within the vagina if non absorbable are usually left until the twelfth day for not only does their removal involve trauma to the line of union but firm union is not established until that date Before taking them out the line of union is cleansed with some weak antiseptic lotion which removes the crusts of exudate and makes the sutures more readily visible

BOWELS After a vaginal operation an aperient may be ordered on the third evening following operation and this may be followed by an enema on the next morning After perineorrhaphy especially if the anal sphincter has been involved the bowels are sometimes confined up to a week when an aperient preceded by an enema of warm olive oil may be ordered If an enema is given, the tube must be very gently inserted into the bowel and great care taken to avoid pressure on the anterior wall of the rectum

After each action of the bowels the wound and surrounding parts must be cleansed with some weak antiseptic solution If mopping is adopted the anus should be wiped from before backwards so as to avoid wiping any fæces towards or into the wound On the other hand when irrigation is decided upon the patient should be turned on the left side the buttocks drawn to the edge of the bed and a Kelly s pad, which leads to a pail on the floor placed under them The wound can then be gently irrigated with weak antiseptic solution and when it is quite clean it should be dried with sterilized swabs and a fresh dressing applied

CHAPTER 28

THE URINE

In most surgical patients it is important that the amount of urine passed is measured and recorded The kidneys are unable to excrete the waste products from the body unless at the same time they are excreting an adequate amount of water

Each specimen of urine should be placed in tall conical urine glasses so that its odour colour clearness or opacity may be noted it is well to notice if the urine is passed clear and whether it changes on standing

In addition, the nurse should note if there is any difficulty in passing the urine

Urine Analysis The normal quantity of urine passed by a healthy adult in twenty four hours is about 1 500 ml or 50 ounces but abnormal conditions such as profuse sweating or copious imbibition of fluid may cause great variations in the daily quantity

Normal urine may vary from a faint yellow to a brownish red

The specific gravity of the urine depends upon the weight of the mineral salts which it holds in solution The specific gravity is taken by a urinometer and in health it is between 1015 and 1025

The acidity of fresh urine is due to the presence of acid salts chiefly the acid phosphate of sodium and this can be demonstrated clinically by litmus paper

In certain conditions the urine may contain other substances such as albumin sugar bile blood or pus

Examination of the Urine

Test for Albumin Before applying any of the following tests the urine should be perfectly clear If it is not clear it must be filtered

Heat Test This test depends upon the fact that if clear *acid* urine containing albumin is boiled it becomes turbid Turbidity on boiling may also be produced by phosphates but in such a case the urine will become clear immediately on the addition of a few drops of nitric or acetic acid

The clear urine should be tested with litmus paper and if alkaline should be acidified with one or two drops of acetic acid The test is performed by pouring some clear acid urine into a test tube and boiling the upper part if it remains clear and the reaction is still acid no albumin is present

Tests for Sugar Fehling s Test depends on the fact that sugar (dextrose) when boiled in the presence of a strong alkali is capable

DOUCHES Owing to sloughing of the injured parts and separating of the ligatures the vaginal discharge may become somewhat offensive by the tenth day If so a vaginal douche may be given twice daily

BOWELS The bowels are opened about the fourth day, and after each evacuation the same precautions must be observed as described above for perineorrhaphy

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of reducing cupric hydrate (blue) to cuprous hydrate, which appears as a yellow precipitate

A test tube is filled to the depth of one inch with equal parts of Fehling s No 1 and No 2 solutions and boiled and then one or two drops of the suspected urine are added With a little more boiling a yellow precipitate is thrown down, if not, a little more urine is added and the boiling repeated

The preliminary heating is to see that the Fehling s solution is fresh and will not undergo reduction alone Care must be taken to ensure that the precipitation of the yellow cuprous hydrate is fairly rapid and granular for there are other substances present in the urine which with prolonged boiling give a yellow precipitate with Fehling s solution

Benedict s Test overcomes most of the errors of Fehling s reaction and is performed as follows —

Take eight drops of the suspected urine in a clean test tube add one inch of Benedict s solution and boil vigorously for two minutes, and then allow to cool If dextrose is present the reagent will change colour from clear blue to an opalescent green, or, if a large quantity of dextrose is present in the urine the final colour will be an opaque red

Tests for Bile During an attack of jaundice bile pigment appears in the urine if bile is present in large quantities the urine has a greenish brown colour and a yellowish froth forms on shaking

Gmelin s Test The suspected urine is poured into a test tube upon a layer of fuming nitric acid If at the line of contact a coloured ring is formed which changes from green to violet then to red and finally yellow bile is present In practice the essential point is that the green is separated from the yellow colour by purple or reddish tinges

Healthy urine on the other hand will give a purple or reddish colour, but no green will be seen unless bile is present

The test can also be performed by placing a drop of urine on a white porcelain slab or filter paper and allowing a drop of nitric *acid to fall upon it a play of colours will occur—green, blue red* to yellow

Tests for Blood If the urine contains only a small amount of blood it has a peculiar opaque appearance to which the term ' smoky is applied Large quantities of blood give to the urine a red colour varying in intensity up to a bright scarlet Microscopic examination of a centrifuged deposit when red and white blood corpuscles are identified, is the most satisfactory test

Guaiac Test Fill a test tube one third full of urine add one or two drops of tincture of guaiacum and shake A white precipitate forms owing to the partial precipitation of guaiacum resin Now carefully pour ozonic ether down the side of the inclined test tube on to the urine if blood is present a blue colour appears at the junction

of the two fluids The reaction does not always occur immediately, so the tube should be allowed to stand for a short time

The administration of iodides for example iodide of potassium will cause the urine to give this reaction although no blood is present Pus gives a greenish blue colour which disappears on heating

Tests for Pus POTASH TEST If liquor potassii hydroxidi is added to the sediment in the urine a ropy gelatinous mass results when pus is present

The best test for pus is microscopical examination of the centrifuged deposit of a suspected urine Chemical tests are unreliable and are now seldom used

Test for Diacetic Acid Diacetic Acid in the urine is the result of increased fat metabolism and hence in most cases the cause of its appearance is under nutrition or the failure of the absorption of food It is also found in the urine from diabetic patients who are not com pl tely controlled by their insulin and diet

FERRIC CHLORIDE TEST Add drop by drop a solution of ferric chloride to the urine at first a precipitate of phosphates occurs, but on adding more ferric chloride a Burgundy red colour develops if diacetic acid is present in moderate amounts

This colour never develops with acetone but it may be given if the patient is taking certain drugs, *e g* salicylic acid or phenol but these drugs differ from diacetic acid in still giving the reaction after the urine has been boiled

Test for Acetone Even when present in quite small amounts both acetone and diacetic acid give a positive reaction to Rothera s test To half a test tube of the suspected urine add half an inch of mixed crystals of ammonium sulphate and sodium nitro prusside, powdered in proportion of 20 parts of ammonium sulphate to one part of nitro prusside Pour on to the surface of this mixture one drachm of liquor ammoniæ fortis and an amethyst ring develops at the junction of the two fluids if acetone is present If the whole tube is shaken a delicate permanganate tinge which gradually deepens diffuses through the mixture

Test for Chloride Fantus test for chloride in the urine is described in Chapter 15

The Deposits in Urine MUCUS is a normal constituent of urine and forms a woolly looking cloud which usually settles in the bottom of the glass if there are traces of blood in the urine the mucus is often stained a rusty tint

PHOSPHATES OF CALCIUM AND MAGNESIUM may separate out as a milk white deposit if the urine is alkaline they are readily recognized since the deposit dissolves on the addition of some weak acetic acid

URATES form a brickdust deposit in concentrated or highly acid

urine they can be easily discerned from the fact that, although they do not dissolve on the addition of acetic acid, they rapidly disappear on warming or on adding liquor potassii hydroxidi to the urine

PUS forms a heavy white deposit, but differs from phosphates in not being dissolved by acetic acid and, furthermore it forms a ropy gelatinous mass on the addition of liquor potassii hydroxidi

URIC ACID forms a scanty deposit of dark brown crystalline grains sometimes known as 'cayenne pepper' deposit

Incontinence of Urine Incontinence of urine may be true or false It consists in the involuntary escape of urine from the bladder and although due to many different causes certain well defined types can be recognized

TRUE INCONTINENCE True incontinence occurs when the bladder is cut off from its cerebral control The urine which escapes consists then of the whole contents of the bladder

(i) *Passive Type* where the urine dribbles away from a flaccid bladder in this type the sphincter is paralysed

(ii) *Active Type of Reflex Incontinence* Where owing to the abolition of cerebral control the bladder reverts to the 'automatic flushing cistern' of the child *i e* it is emptied without the knowledge of the patient every few hours Reflex incontinence usually results from lesions of the spinal cord above the lumbar enlargement

FALSE OR OVERFLOW INCONTINENCE In this case the bladder is over distended with urine and the sphincter urethrae becomes in competent through mechanical pressure *i e* the escape is the overflow from an over distended bladder The overflow is usually the result of prostatic or urethral obstruction or less often, of paralysis of the third and fourth sacral nerves False incontinence differs from true incontinence in that the patient suffers from the pain or discomfort of retention of urine

The treatment of incontinence of urine is discussed in Chapter 33

Retention of Urine Retention of urine may occur from want of expulsive power of the muscular coat of the bladder or from obstruc tion to the outflow of urine from that viscus The lack of expulsive power may be due to shock or atony over distension or paralysis of the bladder

It is necessary to distinguish between retention due to obstruction and that due to atony In the former the patient complains of pain and discomfort from the recurrent spasmodic attempts of the bladder to overcome the obstruction whilst in the latter case the patient experiences neither pain nor the desire to empty the bladder In both varieties the bladder is distended and appears as a rounded tumour above the pubis like a six months pregnant uterus

If retention of urine is not relieved, it may lead to permanent atony of the bladder, rupture of the bladder, or overflow incontinence

In post operative retention the pain should be relieved by injections of pethidine or of morphia, and hot fomentations may be applied to the suprapubic region If possible the male patient should be stood out of bed If there is still no success an injection of 0 25 mg of carbachol will often give relief, but when it does not a catheter should be passed with, of course, full aseptic precautions

After catheterization it is sometimes advisable to instil into the bladder ℥ss of a 10 per cent solution of Argyrol (silver vitellin)

In cases of chronic retention due to obstruction and a large amount of residual urine release of pressure in the bladder is liable to induce either uræmia or hæmaturia In such cases the patient must have the bladder emptied gradually A sterilized wooden spigot is inserted into the proximal or basal opening of an indwelling catheter, and five to eight ounces of urine are allowed to escape every hour The intake and the urinary output are both measured, and an endeavour is made to keep the output above two pints a day

Another method is to pass a No 7 ureteric catheter or filiform bougie into the bladder and to allow the urine to dribble away

Suppression of Urine, or Anuria Suppression of urine or anuria indicates failure of the secretion of urine from the kidneys and differs from retention in that the bladder is empty

The causes of suppression are two —Obstructive when the suppression is due to blocking of both ureters and the rise of pressure in the pelves of the kidneys and non obstructive due directly to interference with the function of the kidneys The latter is both reflex and toxic in origin and may be due to prolonged shock incompatible transfusion etc

In cases of anuria we must immediately treat the cause when this is possible and we must give the kidneys little work to do until they recover their function Accordingly the fluid intake is restricted to 1 litre per day since this can be excreted by routes other than the kidney No diuretic is given lest the damage to the kidneys is increased No protein is given and the daily requirements of 2 500 calories are given as glucose and peanut oil The diet recommended by Bull is very suitable for this purpose and consists of —

Glucose	400 grammes
Peanut oil	100 grammes
Acacia	as required
Water	to 1 litre

This mixture is given slowly along a tube into the stomach Any vomitus is filtered and the fluid obtained is returned to the stomach by the tube so that the fluid and the electrolyte balance will be maintained

This regime is continued until the urinary output is at least 1 litre per day A diet similar to that used in patients with nephritis is then started and gradually increased

ARTIFICIAL KIDNEY In cases of anuria some of the waste products which have accumulated in the blood stream may be removed by dialysis This is a process in which the heparinized blood is brought in contact with a semipermeable membrane in a machine Some of the substances in the blood diffuse through this membrane and are removed The blood passes to the artificial kidney from an artery and it is returned to a vein

The use of the artificial kidney is a very complicated process and it can only rarely be used

Urinary Fever *Urinary fever urethral fever*, and *catheter fever* are old fashioned terms for a condition which is almost unknown at the present time It is a fever usually of short duration which used *to follow the passage of a sound or catheter along the urethra* The infection arose from infected instruments infected urethra, or infected urine, and the fever was due to the absorption of organisms through an abraded mucous membrane

TREATMENT Rigid asepsis is the most efficient means of preventing urinary fever Urinary antiseptics should be administered and an infected urethra washed out prior to catheterization

If pyrexia or a rigor follows instrumentation, treatment should consist of rest in bed and the use of urinary antiseptics antibiotics a bland liquid diet and perhaps diuretics No further catheter or other instrument should be passed until the condition settles down

CHAPTER 29

THE KIDNEYS, BLADDER AND PROSTATE

OPERATIONS ON THE KIDNEY

THE chief operations performed on the kidneys are —

Nephrotomy where the kidney is incised, usually for stone (nephro lithotomy)

Nephrostomy where the kidney is opened and drained either temporarily or permanently

Nephrectomy or excision of the kidney

Nephropexy in which an abnormally movable kidney is fixed in position

Preparation For several days preceding operation on a kidney and during the after treatment the total urine secreted each day should be measured At least one specimen per day should be carefully tested



FIG 275 Ureteric gum elastic catheter graduated in centimetres opaque to X rays and 30 inches long

During the pre operative period, particularly if nephrectomy is contemplated, it is customary to assess the efficiency of the excreting cells of the kidneys

A preliminary course of treatment with urinary antiseptics such as one of the sulphonamides should be carried out for several days in order to render the urine as aseptic as possible In addition, the patient is given an excess of fluids say 4 to 6 ounces of fluid hourly whilst he is awake An extensive area of skin in the renal region should be carefully purified before operation

Position during Operation There are two methods of approaching the kidney namely the lumbar and the abdominal routes For the lumbar route the patient is placed on the sound side, the upper knee being flexed to prevent any rolling forwards of the patient and a sand bag air cushion or back rest is placed under the dependent loin to increase the distance between the twelfth rib and the innominate bone of the pelvis

For the abdominal route the bridge of the table may be raised under the epigastrium, to make the loin prominent

This regime is continued until the urinary output is at least 1 litre per day A diet similar to that used in patients with nephritis is then started and gradually increased

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FIG 276 An X ray photo graph showing a ureteric catheter in each ureter



FIG 277 Retrograde pyelogram

After cystoscopy and ureteric catheter ization several ml of a radio opaque solution Pylectan have been injected into the pelvis of each kidney and then an X ray photograph taken

The abdominal or transperitoneal approach to the kidney involves the same preparation and position as for laparotomy

After-treatment POSITION For the first few hours after operation on a kidney the patient should be placed in the recumbent position with soft pillows arranged under the shoulder and pelvis of the affected side so as to prevent pressure on the wound Later the patient should be propped up in order to establish free drainage down the ureter

After nephropexy the patient should be confined to bed for at least three weeks and he or she should be nursed with the foot of the bed raised about six inches on blocks in order to relieve any strain on those retaining sutures which are fixing the kidney At the end of this period a proper abdominal support or corset should be worn for at least another six months

The pre operative urinary antiseptics should be re instituted after operation

THIRST As soon as possible fluids such as warm water weak tea barley water etc are given freely by the mouth to promote a free flow of urine

DIET The diet does not differ greatly from that after laparotomy except that with a view of lessening the work of the kidney the patient should avoid large quantities of proteins

DRESSINGS The dressings are changed as often as any blood or urine soaks through, if the contiguous

of irritation, it may be coated with an ointment consisting of zinc oxide ointment diluted with castor oil

DRAINAGE TUBES In cases of nephrotomy a drainage tube is usually passed from the posterior angle of the wound down to the kidney to allow free drainage if any leakage of urine occurs

In clean cases this tube will be removed on the second day, but where sepsis exists it should be retained as long as any permanent discharge is present and then gradually shortened

On the other hand, in cases of abscess of the kidney or pyonephrosis *drainage of the kidney* is commonly employed A rubber drainage tube is inserted into the kidney sac and the tissues behind the sac are also drained When the urine is infected, the cavity of the kidney should be freely irrigated twice daily and the drainage tube should not be discarded until the discharge from the cavity ceases to be purulent When repair of the cavity takes place the urine follows its normal route through the ureter and the drainage opening gradually heals

GETTING UP Except after a nephropexy getting up is generally allowed between the fourth and the eighth days

Complications HÆMORRHAGE may occur down the ureter, when it causes hæmaturia or it may escape *via* the wound

Hæmaturia occurs to a greater or less degree after every operation where the kidney has been incised, but it is usually of no great importance and ceases in two or three days On the other hand, if the hæmaturia is sufficient to cause clots their passage down the ureter will give rise to renal colic When the clots reach the bladder they cause some vesical irritability and may suddenly arrest the urinary flow owing to mechanical obstruction but this is usually not very severe and the bladder symptoms promptly disappear when the long worm like clots are passed

In rare instances when hæmorrhage from the kidney is copious and clots form in the bladder it is necessary to evacuate them by washing out the bladder through a large catheter If the hæmaturia is severe 16 2 mg (gr ¼) of morphia should be administered hypodermically and an ice bag applied over the wound

If the blood escapes from the wound the latter should be tightly packed with gauze and arm pressure applied

SHOCK is treated in a similar manner to that occurring after other operations

CELLULITIS is likely to happen when the urine is extremely foul the soft parts are much bruised or if the surgeon fails to provide free drainage

FLATULENT DISTENSION of the abdomen is often very troublesome and should be treated by passing a rectal tube

SUPPRESSION OF URINE See Chapter 28

RETENTION OF URINE is a common complication after operations on the kidney, and should be relieved by catheterization

URÆMIA may occur when the other kidney is diseased, but modern methods of examination have made its occurrence less common after operations on a kidney The urine becomes very scanty and finally may be practically *nil*, the patient develops constant hiccough vomiting subnormal temperature, irregular pulse and towards the end tremors and drowsiness

PAIN Renal colic occasionally occurs after kidney operations and may be due to blood clot or a fragment of a stone passing down the ureter In these cases the best plan is to relieve the pain by morphia apply hot stupes to the loins and give the patient copious hot drinks to increase the flow of urine

Morphia should always be given with caution in kidney cases and it is inadvisable to give more than ¼ grain (16 2 mg) at any one time

PERMANENT RENAL FISTULA Occasionally nephrostomy is performed in order to produce a permanent renal fistula In such cases Watson s apparatus for collecting the urine may be worn It is a modification of Irving s suprapubic apparatus which is used to drain the bladder it drains away the discharge keeps the patient s clothes dry and allows him to go about with confidence

OPERATIONS ON THE BLADDER

The chief operations performed on the urinary bladder are—

Catheterization See Chapter 7

Cystotomy or Lithotomy, in which the urinary bladder is incised

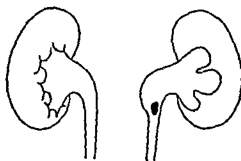


FIG 278 Diagram showing the formation of a hydronephrosis after a stone has become impacted in the uretero pelvic junction

Cystostomy, in which the bladder is opened and drained The opening into the bladder is usually above the pubis (suprapubic cystostomy)

In those conditions for which cystotomy is usually indicated namely severe cystitis stone bladder tumours or enlarged prostate the urine is generally infected and it becomes necessary to drain the bladder

Cystectomy, where whole or part of the bladder is excised

Litholapaxy, an operation of crushing a stone in the bladder by

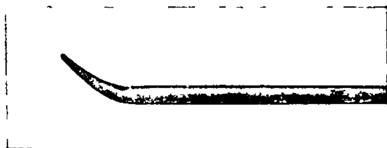


Fig 279 Tiemann s rubber catheter

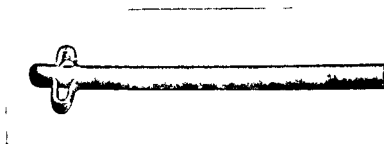


Fig 280 Malecot s self retaining rubber catheter

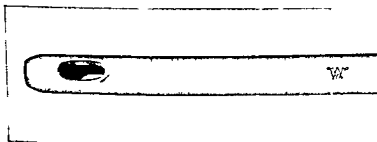


Fig 281 St Peter s Hospital suprapubic rubber catheter with a terminal and two lateral openings

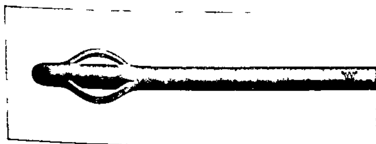


Fig 282 Dowse s self retaining rubber catheter

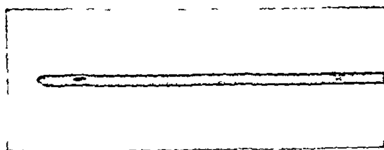


FIG 283 McCarthy s whistle tip rubber catheter



FIG 284 Pousson s self retaining rubber catheter



FIG 285 Winsbury White s suprapubic self retaining rubber catheter

a lithotrite and removing the fragments by means of a suction pump or evacuator

Cystostomy PREPARATION In general the preparation is the same as for operations on the kidney

The urine must be measured tested and charted daily and the function of the kidneys should be evaluated

If the bladder is infected and there is no urethral obstruction, it should be washed out with weak antiseptic lotion for several days prior to operation with the object of cleansing its mucous membrane

Throughout the treatment urinary antiseptics should be administered

POSITION DURING THE OPERATION The patient is placed in the dorsal or Trendelenburg position according to the practice of the surgeon

After anæsthesia is induced the bladder may be irrigated and left distended in order to increase the extra peritoneal area of the bladder above the pubis

At the conclusion of the operation a large sized de Pezzer catheter or a White s tube is introduced through the upper angle of the vesical wound and secured therein by a purse string suture so as to form a water tight joint

Whatever type of suprapubic tube is used it should be connected to a sterile bottle under the bed by a length of sterile rubber tubing This bottle must not be raised above the level of the patient without its being disconnected, otherwise the fluid in it may run back into the bladder

The suprapubic tube is withdrawn about the seventh day, the intravesical flange crumples up and passes through the wound without any difficulty

After treatment In all bladder operations two objects the nurse must have in view are to keep the patient dry and to keep the urine uninfected

Pain is best alleviated by morphia and belladonna, but if the kidneys are at all diseased morphia must be used with caution

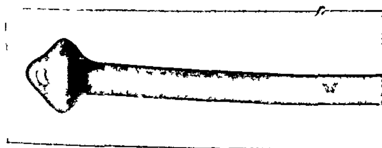


Fig 286 De Pezzer s self retaining rubber catheter

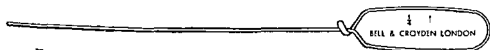


Fig 287 Catheter introducer for de Pezzer s and Malecot s catheters

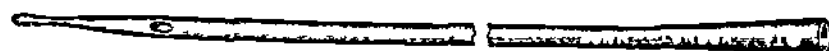


Fig 288 Olivary gum elastic catheter

Dressings Occasionally the dressings become soaked with urine, and if left in contact with the skin they soon give rise to great irritation To prevent this the dressings should be frequently changed, and the skin of the abdomen the scrotum and the upper part of the thighs should be smeared at each dressing with an ointment composed of zinc oxide ointment 1 part and castor oil 2 parts

In other words, the patient may require attention at frequent intervals both by day and night, the dressings and draw sheet being changed many times and sometimes the pyjamas also

Drainage Tubes Prolonged drainage of the bladder results in lack of control of urination therefore, the suprapubic tube should be removed at the end of about seven days After the suprapubic tube has been taken away, one of the various methods enumerated below for keeping the patient dry may be tried

At the end of about the tenth day the patient should be instructed to pass some urine spontaneously and, if he fails the bladder should be catheterized every six to eight hours

Irrigation The bladder should be washed out once or twice daily until all evidence of inflammatory exudate disappears This is best performed with an apparatus such as that of Dukes and using oxy cyanide of mercury (1 in 10 000) This apparatus is connected to the de Pezzer catheter (See Chapter 26) Failing this a rubber tube

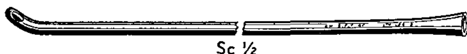


FIG 289 Coudé gum elastic catheter

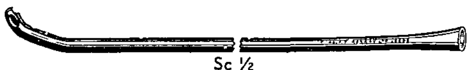


FIG 290 Bi coudé gum elastic catheter

and funnel may be connected as required to the suprapubic tube, but that is much more likely to be followed by contamination and infection of the urine

Urinary antiseptics such as hexamine or pyridium one of the sulphonamides or an antibiotic depending on the sensitivity of the infecting organism should be given

When the urine is alkaline on being voided ammonium benzoate or ammonium chloride may be given in large doses and if the urine is very foul and cystitis present the bladder should be irrigated three or four times daily with mild antiseptic lotion

Methods of Keeping the Patient Dry *Siphonage* is not as a rule very reliable for it acts too powerfully and tends to suck in air which at once interrupts its action

In this case a catheter inserted into the bladder is connected to a length of rubber tubing which is carried to a receptacle for urine placed below the bed

Overflow Apparatus This has the advantage that it can be applied at the time of operation and used until the suprapubic wound is

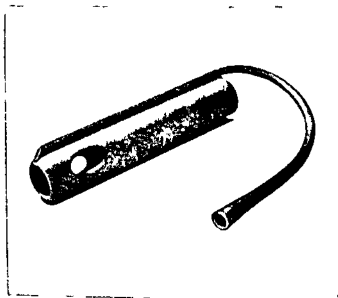


FIG 291 Marion's suprapubic drainage tubes The smaller tube is used for irrigation and the larger provides free drainage

healed Irving's apparatus is composed of a celluloid cap shaped like a straw hat with a removable perforated lid the cap is fastened over the wound by means of a rubber belt passing round the abdomen and any tendency to slip upwards is counteracted by two perineal tapes The urine escapes by two openings in the lower part of the circumference of the cap which are provided with rubber tubes to conduct the urine to a urinal between the thighs Inside the box a

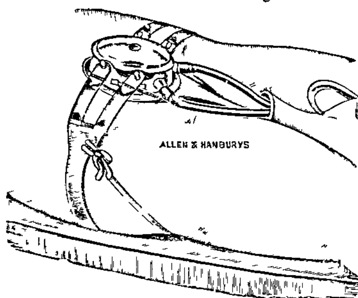


FIG 292 Irving's overflow apparatus

gauze bag of large boric crystals may be placed and these are renewed every twelve hours The crystals are dissolved by the urine and form an antiseptic lotion Every day the box is removed cleaned and boiled and the bladder flushed out with an antiseptic lotion It must be remembered that an Irving s apparatus will not work efficiently when the foot of the bed is raised

COMPLICATIONS OF CYSTOSTOMY *Suppression of Urine*

Epididymitis should be treated by elevation of the part and the application of heat Antibiotics may be given

Pelvic Cellulitis is likely to occur when the urine is extremely foul

A Persistent Suprapubic Fistula following upon simple cystotomy, indicates an obstruction at the neck of the bladder

Cystectomy After partial cystectomy the bladder is usually drained by a large tube inserted suprapubically, and the after treatment does not differ in detail from that of cystostomy

Litholapaxy The patient should be kept in bed for a week and for the first few days should be instructed to turn on his side to pass water He should be warmly clad to avoid chills Pain may be relieved by morphia and the application of hot fomentations to the abdomen and perineum

A 4 per cent solution of ethyl amino benzoate in olive oil has been found to be a very effective bladder analgesic Ten to thirty ml of this solution are instilled into the bladder and if not expelled for thirty minutes the analgesic effect lasts upwards of twelve hours

For the first few days the diet should be light and consist mainly of milk and fluids such as barley water weak tea etc, should be given freely

The complications after litholapaxy are much the same as those of cystotomy except that an ascending renal infection and epididymitis occur more frequently

In certain cases an indwelling catheter may have been introduced by the surgeon with the object of keeping the bladder empty Should the lumen of the catheter become blocked *e g* by clot the obstruction may be removed by gently syringing If hæmorrhage is so profuse as to fill the bladder with clots and it cannot be emptied by syringing either a Bigelow cannula should be passed and the clots withdrawn by means of the evacuator or the bladder may be opened suprapubically and the clots evacuated

Perineal Cystostomy and Urethrostomy When an operation is performed on the bladder or urethra drainage is sometimes obtained by a tube inserted through the posterior portion of the urethra into the bladder

PREPARATIONS FOR OPERATION The perineum is shaved and cleansed and the patient receives the usual pre operative preparation

POSITION DURING OPERATION The operation is conducted with the patient in the lithotomy position

AFTER TREATMENT The after treatment does not differ greatly in detail from that described for suprapubic cystostomy

Dressings A light gauze dressing is applied to the wound and kept in place by a T bandage Such a dressing must of course be changed when it becomes saturated with urine, and at the same time the draw sheet should be changed also

The usual precautions should be taken to prevent irritation of the skin of the thighs and buttocks by the urine

Drainage Tube The flexible rubber tube for perineal urethrostomy resembles a urethral catheter with a terminal opening

Dilatation after external urethrostomy will be started about the fourteenth day, when a full sized metal bougie (14–16) should be passed

Dilatation should be repeated at intervals of about a fortnight for about three months and if no contraction is taking place the intervals between the passage of instruments should be gradually increased If the wound does not soon heal and the perineal fistula shows signs of becoming permanent, it should be excised and the wound sutured

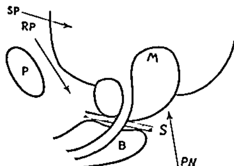


FIG 293 Diagram showing the routes of approach to the prostate gland
SP Suprapubic route through the bladder *RP* Retropubic route in front of the bladder and *PN* Perineal route from below *B* Bulb of the urethra *M* Middle lobe of the prostate gland *P* Pubic symphysis and *S* Sphincter muscle of the membranous urethra

OPERATIONS ON THE PROSTATE GLAND

Suprapubic Prostatectomy PREPARATION The immediate pre operative preparation for suprapubic removal of the prostate gland is similar to that for cystotomy Prior to operation the general condition of the patient is improved as far as possible and certain laboratory tests are performed on the blood and urine to estimate the efficiency of the kidneys

A hæmoglobin value below 10 grammes or a blood urea of 50 mg or more per 100 ml or a urea concentration of 1 5 per cent or less prohibits immediate prostatectomy

High blood pressure cardiac insufficiency and other diseases of old age greatly increase the risk of the operation

Where the kidney efficiency is inadequate preliminary drainage of the bladder may be carried out either by the performance of a supra pubic cystostomy (two stage prostatectomy) or by inserting an indwelling catheter into the bladder

gauze bag of large boric crystals may be placed and these are renewed every twelve hours The crystals are dissolved by the urine and form an antiseptic lotion Every day the box is removed cleaned and boiled and the bladder flushed out with an antiseptic lotion It must be remembered that an Irving s apparatus will not work efficiently when the foot of the bed is raised

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The complications after litholapaxy are much the same as those of cystotomy except that an ascending renal infection and epididymitis occur more frequently

In certain cases an indwelling catheter may have been introduced by the surgeon with the object of keeping the bladder empty Should the lumen of the catheter become blocked *e g* by clot the obstruction may be removed by gently syringing If hemorrhage is so profuse as to fill the bladder with clots and it cannot be emptied by syringing either a Bigelow cannula should be passed and the clots withdrawn by means of the evacuator or the bladder may be opened suprapubically and the clots evacuated

Perineal Cystostomy and Urethrostomy When an operation is performed on the bladder or urethra drainage is sometimes obtained by a tube inserted through the posterior portion of the urethra into the bladder

PREPARATIONS FOR OPERATION The perineum is shaved and cleansed and the patient receives the usual pre operative preparation

suprapubic tube is not used, a catheter will be inserted along the urethra and this is connected to a sterile bottle

AFTER TREATMENT The after treatment of cases of suprapubic prostatectomy differs in some respects from that already described for suprapubic cystotomy

Drainage Tubes If there is a suprapubic tube, this may be replaced on the fourth or fifth day by a smaller tube

Dressings By the above methods of drainage the patients can, in most instances, be kept dry and comfortable, and the dressing need only be changed once a day, but, should urine leak alongside a suprapubic tube, frequent changing will be required

Urethral Micturition After the seventh day the tube should be periodically clamped, so as to allow urine to accumulate in the bladder and the patient then makes frequent attempts to pass urine *per urethram* At first only a few drops will be expelled but gradually the amount increases

On the tenth or eleventh day a suprapubic tube is removed and replaced by a Hamilton Irving apparatus and until the suprapubic wound heals the bladder is irrigated once or twice daily

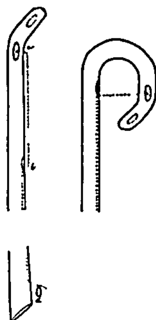


FIG 295 Self retaining indwelling catheter (Millin) After the catheter is inserted the thread which is shown as a broken line is tightened

After removal of the suprapubic tube and until the suprapubic wound is soundly healed, some surgeons drain the bladder by means of an indwelling catheter This should be of soft rubber with several lateral holes so as to drain not only the bladder but also the prostatic cavity

The urine should be voided entirely along the urethra after two or three weeks

Fluids A high intake of fluids is essential after any prostatectomy, and a careful fluid chart should be kept Many of these patients will only take sufficient fluid if they are closely watched and encouraged

Diet The patient should be given light nourishing food that will not tax the excretory powers of the kidney

Bowels The bowels are opened after three or four days by a mild aperient Enemata should be avoided as far as possible as they tend to promote bleeding

Restlessness Some patients display considerable restlessness this may be combated by twenty grains of chloral hydrate with thirty grains of potassium bromide given every four hours until sleep is induced

In cases of concomitant cystitis the bladder should be irrigated at least twice a day with a solution of oxycyanide of mercury (1 in 5 000) The administration of urinary antiseptics and copious fluids is necessary The urine should be kept acid

POSITION DURING OPERATION The patient is placed in the dorsal or Trendelenburg position according to the practice of the surgeon The bladder is thoroughly washed out through a large sized catheter and then distended with ten or twelve ounces of some bland lotion

At the conclusion of the operation a tube is sometimes inserted into the bladder and connected with sterile tubing to a sterile bottle If a

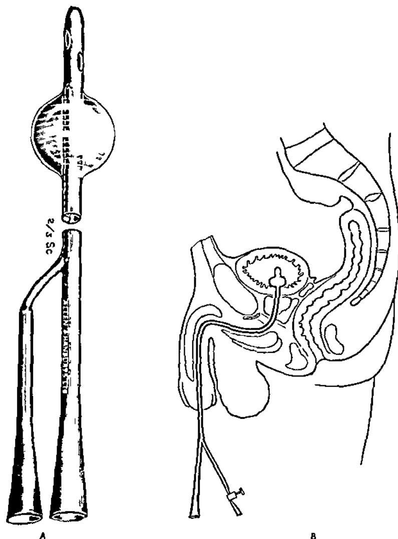


FIG 294 *A* Foley s self retaining catheter *B* Diagram of a male pelvis to show a Foley s catheter with its balloon distended thus preventing its withdrawal from the bladder

As a prophylactic measure Walker recommended passing a full sized Lister s bougie fourteen days subsequent to prostatectomy as a routine

A self retaining indwelling catheter (Fig 295) may be readily constructed by threading a firm rubber or pliable gum elastic coude catheter with a long piece of braided silk by means of a stout cutting needle At (*a*) the catheter is pierced, about one inch from its tip, with the loaded needle one end of the silk is knotted and the knot drawn within the lumen

A hole (*b*) is cut about two inches from the eye of the catheter and the free end of silk drawn through this and down the lumen by means of a long fine probe The silk is again threaded on the needle and passed through the wall of the catheter at its proximal end

After introduction into the bladder, traction on the loose end of silk causes the intravesical portion of the catheter to curl up on itself as shown in the diagram, this position is now maintained either by means of a knot at (*c*) or by a small clip (*d*) This site should be marked on the silk prior to introduction of the catheter

To remove the catheter the silk is cut at (*c*)

Harris' Prostatectomy In Harris operation an attempt is made to secure primary union by undertaking a plastic repair of the prostatic cavity together with subsequent closure of the bladder wall, hence hæmorrhage is controlled sepsis lessened and no large granu lating area is left in the base of the bladder

Urethral drainage is obtained by means of an indwelling catheter secured by a silk worm gut transfixion suture passing through the intravesical end of the catheter and out through the supra pubic wound where it is secured to a glass rod If drainage is impaired the bladder may be gently irrigated with one or two ounces of silver nitrate (1 in 4 000) by means of a syringe The catheter is removed on the tenth day by cutting the retaining suture immediately below the glass rod flush with the skin and withdrawing the catheter together with the residue of the suture

In the modified Harris operation the bladder is not closed completely a rubber tube of medium size being inserted not only as a safety valve in the case of hæmorrhage but also as a means of irrigating the bladder If the control of sepsis is doubtful the surgeon may also insert a small suprapubic drain which is removed after forty eight hours

Endoscopic Resection of the Prostate McCarthy s resectoscope has a loop of wire through which a diathermy current passes By means of this instrument it is possible to remove prostatic tissue through the urethra This procedure is also called a *perurethral prostatectomy*

The bladder and indwelling catheter are irrigated half hourly until the bleeding stops The irrigations are then continued at less frequent intervals until the catheter is removed on the fourth or fifth day

Getting up If his general condition permits, the patient gets out of bed after about three days

Complications *Hæmorrhage* Free drainage of the bladder with continuous irrigation and packing of the prostatic cavity are the means used for treating serious post operative hæmorrhage Constant irrigation with weak silver nitrate solution (1 in 15 000) the flow being delivered at a rapid drip, may be combined with morphia In these circumstances some surgeons prefer a sodium citrate solution (up to 1 per cent) for the vesical irrigation

If copious hæmorrhage persists for some days or recurs severely the prostatic cavity may be packed with gauze round a firm catheter which projects well into the cavity of the bladder The packing should be removed in forty eight to seventy two hours

Alternatively, Oxycel may be wrapped around the balloon of a Foley s catheter, the catheter passed into the bladder, the balloon distended with fluid and then slight traction applied so that the balloon and the Oxycel sit in the prostatic cavity

Sepsis After suprapubic prostatectomy there is a tendency for stagnant urine, blood and mucus to collect in the prostatic cavity, and for infection to spread either from the rectum or alongside the tube from the skin

Continuous irrigation through a catheter in the urethra and an outflow through a suprapubic tube is an effective method of combating such sepsis

Epididymitis In order to diminish the risk of this complication the scrotum and testicles should be suspended on a piece of Elastoplast which passes from one thigh to the other under the scrotum Now adays however, most surgeons divide both vasa deferentia before removing the prostate and this prevents any descending infection into the epididymes

Post operative Obstruction at the Outlet of the Bladder Post operative obstruction at the outlet of the bladder, with persistence of the suprapubic fistula and inability to pass a catheter into the bladder, is occasionally a late complication It is due to imperfect removal of the prostate or to scarring in the prostatic cavity

If the suprapubic fistula has not healed by the end of six weeks, a series of Lister s metal bougies of increasing size should be passed and a large No 16 E or 18 E Jaques catheter tied in the urethra for seven to ten days

If dilatation proves ineffectual or the suprapubic track has not healed at the end of eight or nine weeks the fistula should be excised In addition it may be necessary to dissect out the stricture at the outlet of the bladder where the prostate was removed In either case an indwelling catheter is inserted along the urethra and the bladder closed

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If the catheter becomes blocked before then it is replaced After the indwelling catheter is removed, a catheter is passed every day until the residual urine is negligible

After operation fluids are given freely, a fluid chart is kept, and sulphacetamide or a mixture of three sulphonamides is prescribed

The special complications after this operation are hæmorrhage sepsis and uræmia

Retropubic Prostatectomy In this operation the prostate is removed through an approach which extends down in front of the bladder and behind the pubic symphysis

Some surgeons instil a solution of an antibiotic, such as two ounces of 1/2 000 Neomycin into the bladder at the end of the operation

An hour after operation the spigot is removed from the indwelling catheter and the catheter is then connected by sterile rubber tubing to a sterile bottle at the side of the bed

Millin recommends that the bladder and catheter are washed out only if the drainage of urine is not free A solution such as Monacrin 1/1,000 is then used The abdominal dressing is examined at intervals and, if there is any great leakage of blood into it, the dressing is reinforced with another sterile dressing and the surgeon is informed immediately

The catheter is removed about the fifth day after which the patient will usually pass his urine per urethram If there is any leakage from the abdominal wound or if the patient experiences difficulty on micturition after the removal of the catheter it is necessary to insert a catheter for another few days

Perineal Prostatectomy The perineal approach to the prostate is popular in relatively few clinics The pre and post operative treatment is similar to that of other prostatectomies except that the incision is placed across the perineum in front of the anus and thus special preparation of this area is also necessary

In addition to the usual complications of prostatectomy, incontinence of urine is likely to occur

Transplantation of the Ureters This operation consists of the division of the lower ends of the ureters and their implantation into the sigmoid colon It is performed as the first stage in the treatment of certain cases of carcinoma of the bladder prior to the removal of the bladder in other pelvic malignancies involving the ureters or bladder and in a congenital defect of the bladder called extrophia vesicæ

PREPARATION *Chemotherapy* During each day of the week prior to operation 10–12 Gm of phthalyl sulphathiazole are given orally with 2 Gm of streptomycin also orally This treatment reduces the number of living organisms in the bowel Immediately before the operation 100 000 units of penicillin and 0 5 gramme of streptomycin are given by I M I

Diet A low residue diet is commenced a week before operation, but for the last two days before operation a fluid non residue diet is given As far as possible these diets should be of a high protein high caloric, and high vitamin nature Vitamin C tablets (200 mg) are taken with each meal

Bowels A soap and water enema is given on each of the two days before operation, and, on the day of operation it is followed by a retention enema containing five grammes of phthalyl sulpha thiazole Just prior to leaving the ward for the operating theatre a rectal tube is inserted and left in place

Fluids Any dehydration is overcome and the hæmoglobin content of the blood is raised to at least 90 per cent by transfusion preferably of packed cells

AFTER TREATMENT The streptomycin and the phthalyl sulpha thiazole are continued orally for several days, penicillin (100 000 units) and streptomycin (0 5 Gm) are given by I M I and potassium citrate (1 Gm) and sulphacetamide are usually ordered to reduce infection of the kidneys

Fluids only are given by mouth for the first two days after which a low residue diet is resumed

The rectal tube is removed on the fifth or sixth day

No aperients purgatives or enemata are given till ordered

In children the doses of penicillin, streptomycin phthalyl sulpha-thiazole and sulphacetamide are, of course appropriately reduced for their pre and post operative treatment

Complications The complications include anuria, ascending renal infection, peritonitis localized abscesses, retroperitoneal infection, recurrent renal infections renal calculi and rectal incontinence

CHAPTER 30

SPLINTS, EXTENSIONS AND CASTS

SPLINTS

SPLINTS are made of many different materials, such as wood metal etc and are of various shapes to fit the different parts of the body For the purposes of description splints may be divided into the following groups —

Simple Fixation Splints, which merely serve as a first aid measure to fix the fragments of a fractured bone or to abolish movement of a joint This group may be further subdivided into —

PLAIN WOODEN SPLINTS which are simply pieces of wooden board cut to an appropriate length and width The surface of each splint is flat and the irregularities of the limb are filled in by padding

MOULDED WOODEN SPLINTS

MOULDED METAL SPLINTS

SPLINTS MADE OF STOUT WIRE NETTING OR WIRE GAUZE

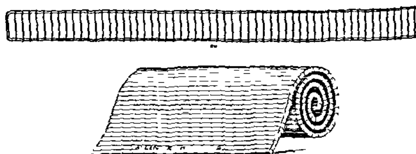


FIG 296 Cramer s wire and Gooch s splinting

GOOCH S SPLINTING consists of strips of soft wood glued to a backing of American cloth (Fig 296) It is rarely used now

PLASTER OF PARIS SLABS Nowadays apart from emergency use most of the above splints have been replaced by plaster of Paris slabs moulded to the shape of the limb

Splints which aid in Overcoming Deformity In addition to the simple fixation of bony fragments or a joint the shape of the splint may determine the shape of the limb

Splints which, in addition to simple fixation aid in producing extension, *e g* Hodgen s or Thomas bed splint

Internal Splints Stainless steel or vitallium plates may be inserted at operation and fixed in position so as to immobilize the fracture These plates are held with screws which extend across the bone In some cases steel or other wire is used to hold the fragments to

and in other cases bone grafts are used Rarely, Kirschner s wires or a special flanged nail (Küntscher s) is inserted down the medulla of the bone

The fracture that is most often treated by internal splinting is that

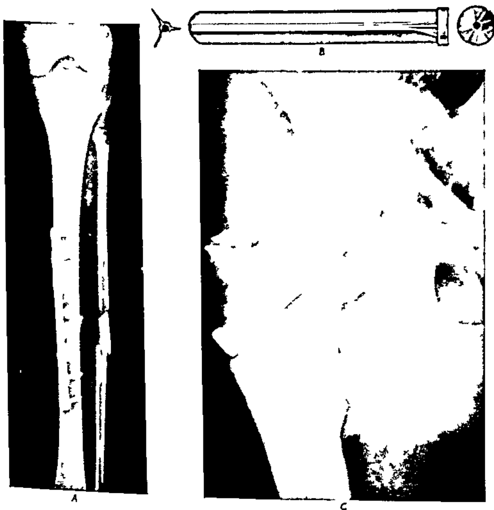


FIG 297 *A* Photograph of an X ray of a vitallium plate on a fracture of the tibia *B* Modified Smith Petersen pin *C* Photograph of an X ray of a Smith Petersen pin used for the treatment of a fracture of the neck of the femur

of the neck of the femur The reason for this is that it is otherwise very difficult to immobilize the proximal fragment of the bone *i e* the head of the femur In this situation a Smith Petersen s nail (or pin as it is often called) is used (Fig 297) This is a three flanged nail which is inserted into the neck and head of the femur through the side of the shaft of the femur just below the greater trochanter

The Application and Cleansing of Splints PADDING OF SPLINTS Every form of splint except some plaster of Paris splints should be

padded before application The padding usually consists of a layer of "padding wool" of uniform thickness and maintained in position by means of a covering of linen If there is a wound the padding should be sterilized before use, and care must be taken that it does not collect in lumps Also the pads must be made sufficiently large to cover the sides of the splints so thoroughly that no hard edges are left unprotected



FIG 298 Photograph of an X ray of a lateral view of a Smith Petersen pin inserted into the neck of a femur in which there is a cervical fracture



FIG 299 Photograph of an X ray of a pin in the neck of the femur and a McLaughlin plate screwed on to the upper end of the shaft of a femur in which there is a pertrochanteric fracture

When the splint is liable to be soiled by excretions or discharge from a wound it should be covered with jaconet or pink mackintosh in order to keep it dry and clean Before the splint is applied the part is well dusted with boric powder and opposing skin surfaces such as the axilla between the fingers etc are also separated by small pieces of cotton wool All hollows must be filled up with pads of cotton wool and bony projections such as the heel etc are surrounded by a nest or ring of padding to prevent pressure on these points and the possible formation of a pressure sore The splints are generally secured by straps and buckles or by a bandage applied over them

For the first few hours subsequent to application of a splint the

limb should be frequently inspected for signs of too tight bandaging or splinting Blueness of the digit or diminution of the pulse indicates undue pressure and consequent risk of ischæmic paralysis or gangrene Any indication of excessive pressure must be reported to the surgeon at once

TOE CAPS A patient with his leg suspended in a splint is liable to suffer from cold toes but this may be remedied by placing a sox or a toe cap, cut out of gamgee tissue over the foot and the end of the splint

CLEANSING OF SPLINTS After use the splints should be cleansed by rubbing them over with a piece of lint soaked in turpentine and thoroughly scrubbing them with hot soda solution and plenty of soap Finally they are mopped over with 1 in 20 phenol lotion dried and repadded

SANDBAGS Sandbags are used as a temporary measure to keep a fractured limb still and in position They consist of bags of tick of suitable size and shape filled with dry sand They are covered with jaconet to keep them dry and clean, and over this should be placed a little linen case like a pillow slip which is removable and washable

Divided Mattress and Pelvic Elevator A divided mattress and a pelvic elevator are useful in the treatment of fractures of the lower limbs sacral bedsores pelvic wounds etc for they contribute both to the comfort of the patient and to the ease of nursing (Fig 300) The mattress may be divided into four portions an upper portion 28 inches long a lower portion 34 inches and two centre pieces 12 inches in length with a handle at each end The upper and lower

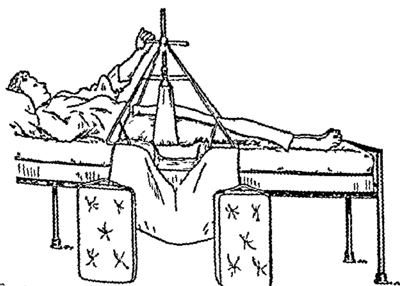


FIG 300 Macewen s divided mattress and pelvic elevator showing the weight of the patient sustained by the elevator and the centre pieces of the mattress withdrawn

portions are covered with a separate blanket mackintosh and sheet and the centre pieces are placed in position uncovered between them A draw mackintosh covered by a draw sheet, is then placed across the bed so as to cover the two centre pieces and then the ends of the draw sheet etc are tucked in on either side underneath the mattress

The elevator consists of a stout metal frame, somewhat in the form of a fracture cradle This has welded to its summit a metal plate, through which passes a screw supporting a cross piece and to which is attached a pelvic band When in use the frame of the elevator is placed on the bed across the patient at the level of the pelvis, the pelvic band is attached to the cross piece, and the elevating screw revolved until the pelvis is raised to the desired height The weight of the pelvis is transferred to the pelvic band thus enabling the centre pieces of the mattress to be withdrawn without allowing the pelvis to sag The sacrum may then be washed or dressed, or the bedpan introduced without movement of the pelvis The elevator is usually so arranged that it may be adjusted by either the nurse or the patient

APPLICATION OF WEIGHT AND PULLEY EXTENSION

Weight extension is applied for fractures joint disease, and other conditions in which it is necessary to rest the part and to prevent the contraction of muscles which might cause overlapping of fragments of bone or flexion of joints

Traction to the Skin The first method is to attach the extending force to the skin by applying bands of Canton flannel or calico using Sinclair s glue or more usually by using the well known zinc oxide adhesive plaster The skin should be shaved prior to applying any adhesive extension In addition the skin should be carefully cleaned by scrubbing with soap and water and then removing all trace of the same with alcohol No antiseptic other than alcohol or ether should be used

Glue and Flannel Method of Extension Sinclair s glue (glue 50 water 50 glycerine 2 calcium chloride 2, thymol 1) is painted on to the skin with a shaving brush taking care that the glue is not too hot and brushing any hairs of the skin in an upward direction Bands of Canton flannel furnished with straps of webbing for tying or buckling on to a stirrup or splint are then immediately applied to the sides of the limb If flannel strips are not available however stout muslin or several layers of gauze may be employed The glue sets very quickly and when it is dry extension may be applied

Great care must be taken that there are no folds or creases in the flannel bands Tickling or burning under the bands denotes irritation and is an indication that the extension must be changed

Adhesive Plaster Extension The extension apparatus commonly used consists of —

(1) Strips of Zinc Oxide Strapping three to six feet long

(ii) A Spreader This is a square piece of wood slightly broader than the sole of the foot, and with a hole in the centre for the attachment of the cord A leather strap and buckle (to which the corresponding piece of extension strapping is attached) may be fastened to each side of the spreader, or the adhesive plaster may be taken down one side of the leg around the spreader and up the other side of the leg

(iii) A Pulley attached to a framework which is clamped to the end of the bed

(iv) Bags of Sand weighing 2, 5, and 10 lbs

(v) Blind Cord A sufficient quantity to extend from the stirrup over the top of the pulley to the weight

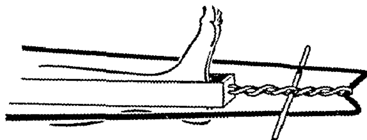


FIG 301 Diagram of the use of a Spanish windlass to obtain fixed extension to the leg

(vi) Flannel and Boric Lint Bandages

(vii) Bed Props to raise the foot of the bed

(viii) A Fracture Cradle

After the leg has been cleaned and shaved strips of adhesive strapping about three inches wide are applied down the outer and inner aspects of the leg from above the knee to about three inches below the sole Over this strapping a gauze bandage is applied to prevent its slipping The upper ends of the strapping should be split for two or three inches so as to form two tails and the edges of the strapping should be notched at intervals so that it may fit the limb more accurately Care must be taken that the strapping lies smoothly on the limb without creases and that there is no overlapping of the two extensions over the crest of the tibia Just above the ankle joint both edges of the strapping should be snipped for a quarter of its breadth and folded over to form a strap about one inch thick thus bringing a non adherent surface next to the foot and ankle If a continuous piece of adhesive plaster is used so that it extends around the spreader and up both sides of the leg the part in contact with the foot and ankle should be covered with another piece of strapping or with a piece of lint The malleoli are protected from the pressure of these straps by the spreader If possible the strapping is left for a few hours so that it will adhere firmly to the skin before the weights are applied

The extension plaster is now connected to the leather straps of the

spreader by means of buckles The spreader is connected to the weight by pulling the cord through the central hole in the stirrup and firmly fixing it with a knot Finally the weight extension should be light at first, then gradually increased An adult may begin with five or six pounds and go up to ten or more pounds, but for children under five years the initial weight should not exceed two pounds The foot of the bed is raised on wooden props so that the weight of the patient s body acts as a counter weight

The bedclothes are kept clear of the extension apparatus by means of a cradle Care must be taken to see that the extension is always acting in the long axis of the limb and that the weight is not resting on anything

The leg to which traction is applied may be supported in a Thomas Corlette s (Fig 306) or Hodgen s (Fig 307) splint, or by a flannel sling

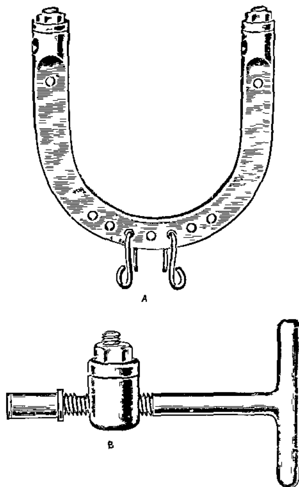


FIG 302 *A* Kirschner s extension stirrup for use with Kirschner s wires *B* Tension apparatus for tightening the wire in a Kirschner stirrup

under the knee after the method of Hamilton Russell (Fig 309) Rarely, it may even just rest on the bed

In young children strapping extension may be applied through both legs from the overhead beam of a Balkan frame (Bryant s method)

Extension is chiefly used in association with the leg, but it can also be applied to the arm

Traction to the Bones A second method of extension is to make traction on the bones themselves by a Kirschner s stainless steel wire or by a Steinmann s pin (Fig 303) The overlying skin is shaved cleansed with soap and water, and then prepared as for a surgical operation before the wire or pin is inserted The site chosen for such insertion is usually in the bone distal to the fracture *e g* the tibial tuberosity for applying traction to a fractured femur Traction is applied to the wire or pin through a metal stirrup which is connected by means of a piece of cord to the appropriate weight

The points where the wire or pin penetrates the skin are protected by means of sterile gauze soaked in an antiseptic

When skeletal traction is to be discarded a swab soaked in 0 1 per cent Cetavlon or Zephiran Concentrate or other similar antiseptic is wrapped around one end of the pin for fifteen minutes and then the

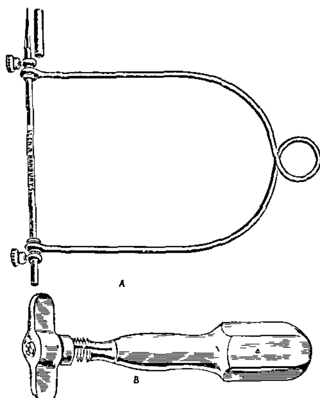


FIG 303 *A* Bohler s stirrup and Steinmann s pin *B* Max Page s handle for inserting Steinmann s pin

pin is withdrawn from the opposite end If a Kirschner s wire has been used it is pushed through from one side for about another eighth of an inch, the wire is treated as above with Cetavlon or Zephiran, then cut off flush with the skin on this side and withdrawn from the opposite side

Unless care is taken during the insertion of the pin or wire to maintain asepsis, and then to prevent infection during the time that it is in place and during its withdrawal infection will spread down into the bone

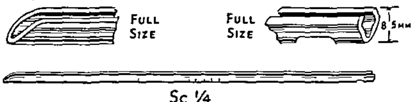


FIG 304 Kuntscher s intramedullary nail for internal fixation of a fractured shaft of the femur etc These nails are made of stainless steel are from 32 to 44 cms long and 8 25 9 and 11 mms in diameter

and give rise to a low grade osteomyelitis which may cause a persistent discharging sinus to develop With care, however, such infection is prevented The dressings covering wounds through which the pin or wire passes should be inspected several times a day to ensure that they

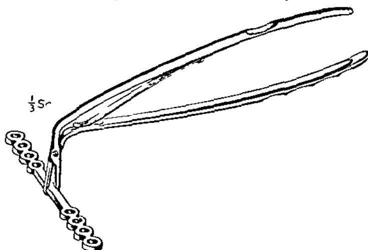


FIG 305 Lane s plate and plate holding forceps

are in place The space between the skin and the sides of the stirrup should be packed up with sterile gauze so that it is not possible by pressure on the side of the stirrup to push into the limb any portion of the wire or pin that has become unsterile

BALKAN FRAME (Fig 308)

The Balkan apparatus which is widely used consists of two wooden end frames one of which is fixed to the foot and the other to the head

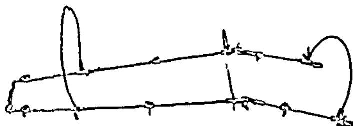


FIG 306 Corlette's splint

of the bed Each end frame is composed of two vertical uprights 6½ feet high united by four screws or carriage bolts to two transverse bars, the lower one about 9 inches above the top of the mattress, the upper about 2 inches from the top of the uprights The upper cross-piece, 3¼ feet long, is notched at regular intervals, as shown in the

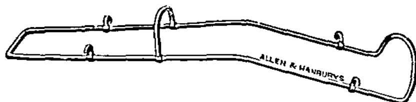


FIG 307 Hodgen's thigh splint

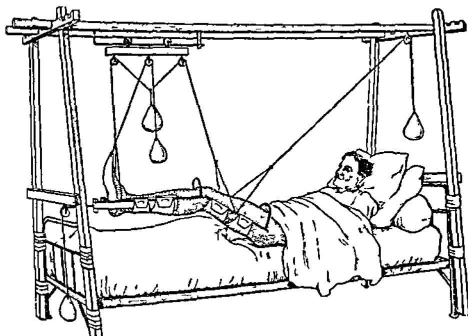


FIG 308 Balkan frame Limb is suspended in a Hodgen's splint If traction is being applied to maintain reduction of a fracture each leg would be supported in a splint with slight abduction at the hips The short over head bar moving on a trolley assists longitudinal movement of the patient up and down the bed but this bar is only rarely used

pin is withdrawn from the opposite end If a Kirschner s wire has been used it is pushed through from one side for about another eighth of an inch the wire is treated as above with Cetavlon or Zephiran then cut off flush with the skin on this side and withdrawn from the opposite side

Unless care is taken during the insertion of the pin or wire to maintain asepsis, and then to prevent infection during the time that it is in place and during its withdrawal infection will spread down into the bone

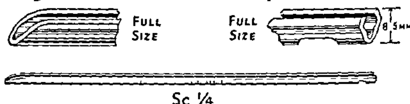


Fig 304 Kuntscher s intramedullary nail for internal fixation of a fractured shaft of the femur etc These nails are made of stainless steel are from 32 to 44 cms long and 8 25 9 and 11 mms in diameter

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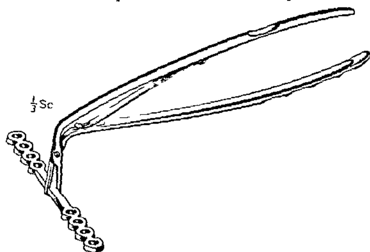


Fig 305 Lane s plate and plate holding forceps

are in place The space between the skin and the sides of the stirrup should be packed up with sterile gauze so that it is not possible by pressure on the side of the stirrup to push into the limb any portion of the wire or pin that has become unsterile

Balkan Frame (Fig 308)

The Balkan apparatus which is widely used consists of two wooden end frames one of which is fixed to the foot and the other to the head

over which extension bands may be tied Adhesive plaster extension is applied in the usual way to the sides of the leg from the ankle up to the site of the fracture The splint, having been bent to an angle of 160° at the level of the knee joint is then slipped over the limb until the oval ring lies firmly against the ischial tuberosity If the fracture is supra condylar in position, *i e* just above the knee joint the splint may also be bent just above the level of the knee joint in order to obtain pressure on the posteriorly rotated lower fragment of the femur The first supporting band, consisting of a double fold of 4 inch flannel bandage is threaded round the inner side bar at the level of the site of the fracture and is then passed below the limb and secured to the outer side bar either by a powerful 4 inch paper clip or by safety pins sufficiently tightly to keep the fractured fragments of the bone at the level of the side bars of the splint

The extension strips are then pulled tight counter extension being made by pushing the ring of the splint against the ischial tuberosity The strips, having been turned round each side bar, are then tied together over the V at the end of the splint which should project 6 to 8 inches beyond the foot The limb is firmly supported whilst the rest of the suspensory flannel bands are applied to form a gutter across the splint These bands should touch edge to edge and should form a posterior support from the buttock to a hand breadth above the heel The knee is padded on its lateral aspects and bandaged to the splint

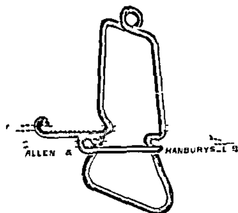


FIG 311 Foot piece for use with Thomas bed knee splint

Counter extension on the ischial tuberosity involves the risk that pressure sores will develop under the ring The nurse will therefore frequently clean the ring by working a strip of bandage soaped or moistened with methylated spirit transversely round it and every four to six hours the skin of the buttock will be displaced up or down to allow a different area of skin to take the pressure The skin is always kept dry and well powdered

The foot end of the splint will be either slung or supported to prevent pressure on the heel and if the foot has been left without a foot suspension piece it will be supported at right angles by a pillow or by flannel bands across a metal foot piece attached to the splint (Fig 311) The suspension of a Thomas splint in a Balkan frame not only avoids these pressure sores but also facilitates control of

diagram, not only to receive the longitudinal bars but also to enable these to be placed in the proper position over the limb to be suspended Only two notches are made in the longitudinal traverses the distance between them being the exact length of the bed The interlocking of the notches prevents any slipping and makes the entire frame rigid The longitudinal traverses are about 8 feet long and project beyond the end frames so as to allow weights to hang beyond the head and

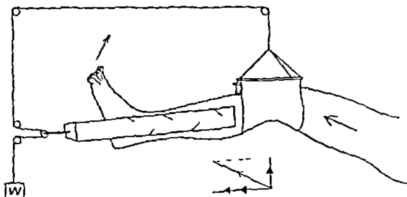


FIG 309 Diagram of Hamilton Russell s method of extension

The direction of the pull along the calf and of the pull upwards through the knee is arranged so that their resultant is in the direction of the line of the femur as indicated by the parallelogram of forces beneath the knee This method of extension is especially useful in a senile patient with a pertrochanteric fracture of the femur At the same time strapping extension with a weight of 1 or 2 lbs may also be applied to the sole of the foot to prevent a foot drop

the foot of the bed Suspension is effected by strong cord passing through pulleys which are screwed into the wooden frame In other words four vertical pillars support a horizontal frame along which suspension pulleys may be attached to allow traction in any direction required

THOMAS BED KNEE SPLINT

Thomas bed splint consists of an oval ring set obliquely on two side bars which ring is firmly and smoothly padded with leather (Fig 310) In many patients a fractured femur is efficiently controlled by a splint having a 22 inch ring but in others splints with rings varying in circumference from 16 to 30 inches may be required The side bars consist of ⅝ inch round iron and end in a notch or V at the foot end

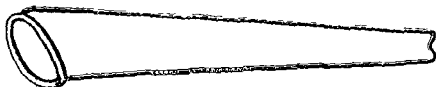


FIG 310 Thomas bed knee splint Usually it is used with 15 to 20 degrees of flexion

over which extension bands may be tied. Adhesive plaster extension is applied in the usual way to the sides of the leg from the ankle up to the site of the fracture. The splint having been bent to an angle of 160° at the level of the knee joint, is then slipped over the limb until the oval ring lies firmly against the ischial tuberosity. If the fracture is supracondylar in position, *i.e.* just above the knee joint, the splint may also be bent just above the level of the knee joint in order to obtain pressure on the posteriorly rotated lower fragment of the femur. The first supporting band, consisting of a double fold of 4 inch flannel bandage, is threaded round the inner side bar at the level of the site of the fracture and is then passed below the limb and secured to the outer side bar, either by a powerful 4 inch paper clip or by safety pins sufficiently tightly to keep the fractured fragments of the bone at the level of the side bars of the splint.

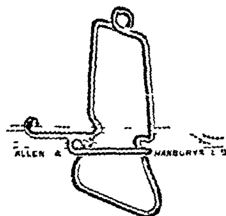


FIG 311. Foot piece for use with Thomas' bed knee splint

The extension strips are then pulled tight, counter extension being made by pushing the ring of the splint against the ischial tuberosity. The strips having been turned round each side bar are then tied together over the V at the end of the splint, which should project 6 to 8 inches beyond the foot. The limb is firmly supported whilst the rest of the suspensory flannel bands are applied to form a gutter across the splint. These bands should touch edge to edge and should form a posterior support from the buttock to a hand breadth above the heel. The knee is padded on its lateral aspects and bandaged to the splint.

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The foot end of the splint will be either slung or supported to prevent pressure on the heel, and if the foot has been left without a foot suspension piece it will be supported at right angles by a pillow or by flannel bands across a metal foot piece attached to the splint (Fig 311). The suspension of a Thomas' splint in a Balkan frame not only avoids these pressure sores, but also facilitates control of

the fracture Furthermore the patient is able to move himself about in bed without pain, and any dressings or bed changing can be accomplished by one nurse The vertical pull is obtained by means of cords from the splint to overhead weights and pulleys the horizontal pull by raising the foot of the bed and either tying the splint to an adjustable vertical bar at the foot of the bed exactly opposite the end of the splint (fixed extension) or by means of weights and pulleys (movable extension) Where the body weight is thus utilized sufficient traction is usually obtained by raising the foot of the bed 10 to 15 inches, but if necessary this effect may be augmented by raising the foot of the bed still higher

As soon as there are clinical and radiological signs of union, which in the case of a fractured femur in an adult is usually about the third month the patient may commence walking with the aid of a walking caliper which if correctly adjusted will prevent any weight being transmitted to the recently united bone A walking caliper differs from the Thomas bed splint in that the two iron side bars of the caliper instead of uniting below are fitted into the heel of a boot and there are leather supports which fix the knee in a position of full extension Thomas bed splint may also be utilized for some fractures of the tibia and fibula

JONES ABDUCTION FRAME (Fig 312)

The hip joint may be immobilized by a Jones abduction frame which is a modification of a double Thomas hip splint and extends from just below the nipples to 5 or 6 inches beyond the sole of the foot The patient is placed on to the frame with the buttocks on either side of the horse shoe shaped gap in the back pad The transverse metal hoops are then accurately moulded around the chest and ribs to prevent side movements of the trunk An adhesive plaster extension is then applied to each side of the legs in the usual way, counter extension being supplied by means of a smooth leather groin strap applied to the opposite leg Extension is maintained by turning the extension bands round each individual side bar and tying them together over the V at the end of each leg piece as with Thomas bed knee splint

The ankle grips which reach just above the malleoli should be well padded A thick pad should be placed under each knee joint and the knees firmly bandaged to the frame

In the application of the frame special attention should be paid to (i) the natal cleft which should just clear the edge of the back pad (ii) the leather groin strap which should always be kept tight and (iii) the extension which should be applied to both limbs much less being required on the sound limb than on the affected one

The following is Sir Robert Jones summary of Nursing Hints for a Patient on an Abduction Frame —

The patient should never be turned for nursing purposes or the spine and limbs will sag laterally '

Place a block underneath the bar between the ankles to avoid pressure on the heels, increasing the height of block when necessary to insert a flat bed pan beneath the splint In this raised position all washing of the buttocks can be done The patient is never taken from the splint nor the bandages removed for this purpose but only the exposed skin washed The feet should be supported at right angles and protected from the weight of the bed-clothes

Remove the groin strap for five minutes four hourly during the first twenty four hours twice daily is usually sufficient afterwards Rub the area with spirit and powder during these intervals replacing strap in the same hole as before, but, as much as possible, over a different adductor skin surface

THOMAS HIP SPLINT (Fig 313)

Thomas hip splint is a flat malleable iron stem about ¼ inch thick and 1 inch wide, which is moulded to the body and extends from the lower angle of the scapula over the buttocks and back of the thigh to about 3 inches above the ankle Three trans verse metal hoops project at right angles from the perpendicular stem and these

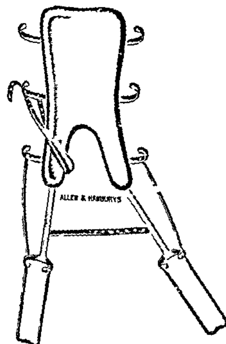


FIG 312 Left abduction frame (Jones)

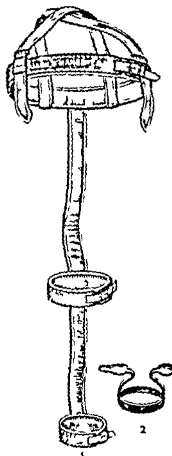


FIG 313 1 Single Thomas hip splint 2 Patten

the fracture Furthermore the patient is able to move himself about in bed without pain, and any dressings or bed changing can be accomplished by one nurse The vertical pull is obtained by means of cords from the splint to overhead weights and pulleys the horizontal pull by raising the foot of the bed and either tying the splint to an adjustable vertical bar at the foot of the bed exactly opposite the end of the splint (fixed extension) or by means of weights and pulleys (movable extension) Where the body weight is thus utilized sufficient traction is usually obtained by raising the foot of the bed 10 to 15 inches, but if necessary this effect may be augmented by raising the foot of the bed still higher

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The following is Sir Robert Jones summary of Nursing Hints for a Patient on an Abduction Frame —

Jones' Humerus Extension Splint (Fig 315)

This splint is a modification of the Thomas bed splint, and has a padded ring 7 inches in diameter, covered with soft leather This passes across the axilla and around the shoulder The attached splint is bent to keep the forearm at right angles to the upper arm, and the crank at the elbow allows the application of an extension apparatus Usually, if little more than the weight of the arm is used as a traction force, the counter pressure of the padded ring in the axilla causes œdema of the arm

On the other hand, if the patient is confined to bed good traction can be provided by weight and pulley extension applied to the lower part of the upper arm The forearm is slung to the bars of the splint by means of flannel bands passed across the back of the forearm and over the side bars where they are pinned

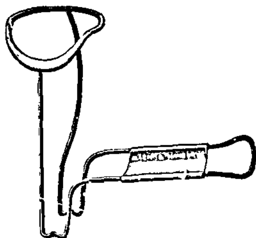


Fig 315 Jones humerus extension splint

Abduction Splint for Shoulder

Fractures of the shaft of the humerus may be treated in a plaster cast with the arm by the side and with the wrist supported in a cuff and collar or in a Jones humerus extension splint but when the fracture is through the surgical neck of the bone *i e* just below its head the proximal fragment will be abducted by the action of the muscles attached to it Accordingly, it is then necessary to abduct the shaft of the humerus to bring the two fragments into line (Fig 326) This may be accomplished by the use of an abduction frame made from Cramer s wire and bandaged to the body and to the arm

The abduction splint is also used when it is desired to rest the shoulder in elderly patients who have some disease process in relation to the joint If the arm is immobilized in the abducted position and movements become very limited at the shoulder joint a useful range of movement of the arm may still be retained by the movement of the scapula on the chest wall

CASINGS OR CASTS

Casings or casts are applied in certain conditions in which ordinary movable splints would be inconvenient They consist of a substratum of different fabrics such as book muslin crinoline house flannel, felt,

encircle the thorax, the upper part of the thigh and the lower part of the leg The splint is padded with boiler felt, covered with ' basil leather, and is attached to the body by straps and buckles fastened to the extremities of the transverse metal hoops The affected leg is firmly bandaged to the splint, and straps pass over the shoulder from the uppermost metal hoop An iron *patten* is attached to the boot on the sound side and this raises the foot of the diseased side completely off the ground and allows the patient to get about on crutches

Owing to the barrel shaped chest in children the splint tends to work round to the front, hence a double Thomas' hip splint or a Jones abduction frame is usually advisable in cases confined to bed Thomas double hip splint differs from a Thomas single hip splint in three respects —

(i) An extra pelvic hoop encircles the body just above the trochanters

(ii) The leg pieces of the splint are abducted,

(iii) The leg pieces are connected at their lower ends by a metal cross bar

BRAUN'S SPLINT

Braun s splint and Bohler s modification consist of iron rods and strips welded together and with pulleys attached as shown in Fig 314 It is used occasionally for the treatment of fractures of the tibia and of the lower end of the femur Traction to the lower leg is applied

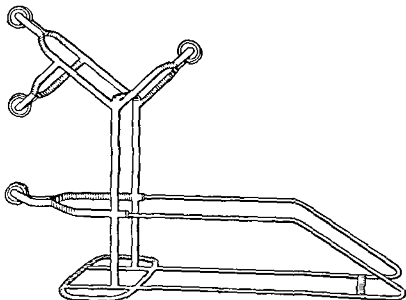


FIG 314 Bohler s modification of Braun s bed splint

by a cord around the lower pulley traction to the upper leg is applied around the uppermost pulley and around the rear pulley traction is applied to the foot to maintain it in a dorsiflexed position

home made variety and they are not used by all hospitals Their high cost per bandage is however, offset by saving of labour and the fact that less bandages are required to obtain sufficient strength than when home made bandages are used If it is desired to prolong the setting time of the Gypsona plaster bandages, a solution of borax should be used instead of water for wetting them A 1 per cent solution of borax, *i e* a tablespoon to the quart prolongs the setting time to eight minutes a 1½ per cent solution prolongs it to fifteen minutes The setting time may be accelerated by the use of warm water or by squeezing most of the water out of the bandage

APPLICATION OF PLASTER OF PARIS BANDAGES The skin should be washed with soap, water and alcohol and then powdered before applying a casing

In applying a plaster of Paris bandage the surgeon may apply a well fitting piece of stockinette and sheet cotton so as to cover the limb from an inch above to an inch below the limits of the intended plaster Bony prominences (ilium, patella and heel) are also protected by felt If swelling is unlikely some surgeons prefer to apply the plaster directly to the skin It is even more important then that it is accurately moulded to the shape of any bony prominences The plaster bandages having been placed end up in a basin of warm water until they are thoroughly saturated *i e* until all bubbles cease to escape are then squeezed at each end and applied to the limb in the usual way from below upwards taking care that no reverses are used since these folds may cut into the skin When the first bandage




FIG 316 The plaster of Paris bandage is held loosely and is immersed until the bubbles cease to rise Then it is lifted from the water and the ends squeezed

(*By kind permission of T J Smith & Nephew Ltd*)

has been nearly applied the nurse places a second in the basin of water squeezes each end (Fig 316) and unrolls a few inches It is then ready to the surgeon After each bandage has been applied, the surface should be smoothed down by the hand and a certain amount

etc, which are impregnated with substances such as plaster of Paris gum and chalk celluloid, waterglass etc, which render them firm and rigid

Poroplastic Felt Poroplastic felt is strong felt saturated with resin *It is sold in the form of large sheets* An area of poroplastic felt, identical in size and shape with a closely fitting paper pattern is cut out by means of a sharp knife held obliquely This is then dipped in boiling water until it is quite soft and pliable carefully dried and then accurately moulded to the limb As it cools the felt becomes rigid and an exactly fitting splint is the result Large casings such as jackets may be made in the same way but as they are difficult to manipulate they are usually made by an instrument maker who uses a steam apparatus to render the material pliable

Plaster of Paris Amongst the first to use plaster of Paris were the early Arabian physicians practising in Spain, but to Kluge of Berlin (1829) belongs the priority of its application to the treatment of fractures

If necessary the plaster should be dried in the oven for some hours before being used A number of different materials such as gauzes book muslin, crinolines and flannel may be used as a basis for preparing these casings but for the smaller ones plaster of Paris bandages are generally used

PREPARATION OF THE BANDAGE The dry powdered plaster is rubbed with the palm of the hand into the meshes of a white muslin bandage of suitable size and length and then the bandage is loosely rolled up so that the different layers are easily movable on one another To guard against unrolling an elastic band is placed round the roll or a pin inserted into the last turn The bandages are then wrapped up in oiled paper or guttapercha tissue or even newspaper and placed ready for use in an airtight jar so that all dampness is excluded and deterioration of the plaster by the absorption of water is prevented

Appropriate injunctions for plaster of Paris bandages are —

1 If possible use 32 mesh crinoline gauze
2 Use dental plaster
3 Fill meshes of crinoline with plaster
4 Tear crinoline into proper strips
5 Pull out loose threads from edges
6 Roll smoothly
7 Store in air tight jars or tin boxes
8 Keep in a dry place

Ready made plaster of Paris bandages are also available (*e g* Gypsona) and thus the time spent in preparing the bandages may be saved With Gypsona bandages the preparation of a plaster cast is facilitated since the plaster sets in a few minutes dries rapidly and is strong and light These bandages are more expensive th

It is usual for the patient to be seen after the plaster has dried, then on the following day, and thereafter as required On each occasion the circulation to the fingers or toes will be examined and the patient will be questioned as to the occurrence of any pain, numbness tingling swelling or alteration in colour of the skin

REMOVAL OF A PLASTER CASING OR CAST A plaster casing or cast may be removed by shears a knife or by a vibrating saw An effective instrument is a pair of Stille s or Lorenz s shears (Fig 317)

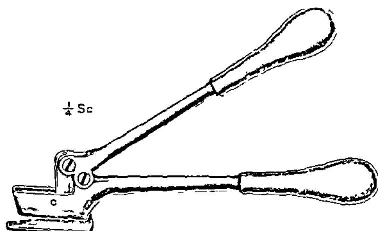


FIG 317 Lorenz s plaster shears

which are very similar in action to Hoffman s and some other skull cutting forceps in that the piece of plaster removed falls out of the window of the cutting blade When a knife is used to cut the plaster the dropping of acetic or weak hydrochloric acid along the path of the knife will greatly simplify this irksome task

Sometimes the plaster is split immediately after application and it can then be removed as required for massage and passive movements

An improved finish may be given to the edges of the plaster by binding them with adhesive plaster

If a piece of rubber tubing about ½ inch in diameter covered with a thick layer of Vaseline is laid along the length of the limb before applying the plaster and is pulled out after the plaster has set a ridge will be left which will permit division of the plaster with much less difficulty (Fig 318)

Bohler s walking iron is applied to the outside of a plaster cast on the lower leg and is fixed in position with further plaster of Paris bandages It consists of an iron bar 20 inches long, ¾ inch wide and ¼ inch thick to which are riveted at both ends two cross pieces 4 inches long ⅝ inch wide and $\frac{1}{16}$ inch thick The iron bar is bent in a U shaped manner so that the bend protrudes as a heel and the limbs are adapted to the outlines of the malleoli It should be applied exactly in the axis of the leg and the distal part projects two finger-breadths beyond

of plaster paste added Finally it is well rubbed by hand in order to furnish a smooth surface

Home made plaster of Paris bandages usually set in about twenty minutes and dry during the course of the next twelve hours To hasten setting salt or alum is added to the warm water To prevent the outer layer of the finished plaster casing from chipping it may be painted over on the following day with white of egg or common *flour paste but if there is any likelihood of the plaster being wetted* by urine or secretions, it should be covered with a coat of shellac or spirit varnish

At the conclusion of the operation the plaster on the surgeon's hands if still moist, can be easily washed off in warm water but if dry it may be removed by rubbing with coarse sugar or glycerine

Considerable care is necessary during the application of a plaster of Paris cast lest pressure sores are caused These are most likely to appear if the bony prominences are not padded or if, while the plaster is setting a joint is moved the plaster is moulded further or the plaster is deformed by pressure of the fingers of the person holding it

If the patient is returning home after the application of the plaster *he should be given a sheet of printed directions instructing* him to report immediately any signs or symptoms indicative of impaired circulation under the plaster The form in use at Sydney Hospital is as follows —

FRACTURE DEPARTMENT

Directions to Patients

NAME OF PATIENT

(1) You have been treated for a fracture of the upper limb / lower

(2) For the next hours you must lie down

(3) During that time in the case of a fracture of any bone in the upper limbs have the hand raised so that it is the most elevated part *of the* body

In the case of the lower limbs (for example a broken ankle) raise the foot of the bed and place the plaster cast on a pillow

(4) You should report to the Casualty Department if you notice any tightness of the plaster cast indications of which will be noticed in the fingers and toes as follows —

(a) Marked swelling
(b) Marked blueness
(c) A severe tight pain which is not eased by elevating the limb
(d) Inability to move the fingers or toes (you should continually move them even while resting)
(e) Numbness or loss of sensation

(5) Report next to the Casualty Office before 9 30 a m on

The walking surface of the iron heel is wound with cotton wool or covered with a piece of leather or rubber, to make it less slippery

The patient should be instructed to walk without rotating the foot and leg with each step

Instead of Bohler s walking iron a firm piece of rubber may be incorporated in the plaster This is held in position by further plaster of Paris bandages but that portion of the heel which will be in contact with the ground is not covered with the plaster bandages With these rubber heels the patient can walk with less rotation of the foot and leg than with a walking iron

Waterglass Casings These bandages are prepared by unrolling and re rolling strips of coarsely woven butter cloth through a neutral solution of silicate of soda They are applied over a piece of stockinette and then the limb is exposed to the air to allow the bandages to dry At the end of a few hours the bandage is usually firm enough to secure immobility of the limb but it continues to harden for about two or three days Waterglass has the advantages that it is light strong and cheap Owing to its solubility in water it is easily removable, but does not lend itself to the formation of a divided plaster

Guttapercha Casing Guttapercha may be used for casings and for this purpose is sold in sheets up to ¼ inch in thickness A paper pattern of the casing required having been obtained, a piece of gutta percha is cut out but it must be an inch or so larger than the pattern in every direction to allow for contraction The guttapercha is placed in a large pan of hot water until thoroughly softened, transferred to cold water for a few seconds and then moulded carefully on to the limb Finally it is secured in position by a firm wet bandage Setting takes about half an hour It is then removed in order that the edges may be trimmed and the splint is padded with boric lint or chamois leather

Unna's Zinc and Gelatine Casing Another form of support or casing is the Unna s paste bandage which is used especially for ulcerated legs The ulcer and surrounding skin are rendered as clean as possible by the use of soap and water and antiseptic lotions in a manner similar to that described for granulating wounds (Chapter 6) A gauze bandage is then applied to the leg from below upwards but without using reverses Gelatinum zinci (Unna s paste) is melted by heat and painted over the outer surface of the bandage Before it sets another bandage is applied and painted over with the liquefied paste and so on As an alternative before they are applied to the leg the gauze bandages may be soaked in melted Unna s paste

With either method the paste solidifies and forms a firm support for the leg but it is usually not used until the ulcer is fairly clean Usually an Unna s bandage is not changed for several days

the heel of the casing The two cross pieces are bent to fit the circum ference of the leg and the whole firmly fixed over the plaster casing by a plaster of Paris bandage, which is especially wound around the cross pieces in order to prevent any slipping of the vertical iron bar

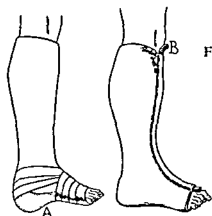
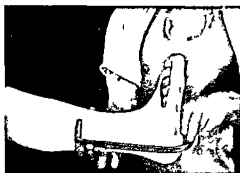
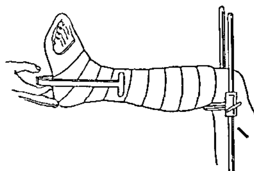
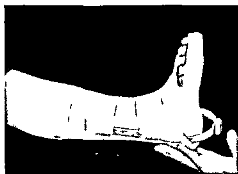


Fig 318 Diagram of a plaster of Paris cast which has been applied to the lower leg and foot and in which a rubber heel (A) is incor porated and a diagram of a plaster of Paris cast which has been applied over a greased piece of rubber tubing (B) When the plaster is dry this tubing is pulled out and when necessary the plaster may be easily split along the ridge







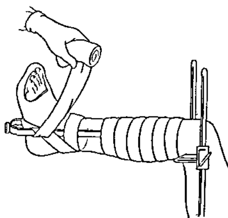


Fig 319 The application of a Bohler walking iron with plaster of Paris bandages During the application of the plaster the foot must be held so that it is at a right angle with the leg thus allowing the toes to clear the ground when the patient walks and thus preventing overstretching of the muscles on the front of the lower leg

(By kind permission of T J Smith & Nephew Ltd)

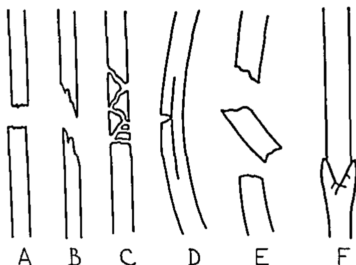


FIG 320 Types of fractures —*A* Transverse *B* Oblique *C* Comminuted *D* Greenstick *E* Double and *F* Impacted

important structures such as blood vessels, nerves viscera, joints etc are injured in addition to the bone For example when a bone is broken its jagged edges may tear an artery or even penetrate some important organ

INCOMPLETE OR PARTIAL FRACTURE This is most commonly seen in children—for example a greenstick fracture, in which a bone cracks without being completely broken across in other words, the bone is partly bent and partly cracked

A SIMPLE OR SUBCUTANEOUS FRACTURE is one in which the skin or mucosa of the nasal sinuses and mouth is unbroken

COMPOUND OR OPEN FRACTURE This term is applied when there is a wound leading down to the fracture In some cases the fractured ends may perforate the skin whilst in others the wound in the skin leading down to the broken fragments is due to the original direct violence

It must always be remembered that a simple fracture may be easily converted into a compound fracture by careless handling

Signs of a Fracture

SIGNS OF LOCAL TRAUMA *i e* pain bruising and swelling occur as the result of the extravasation of blood at and around the seat of the fracture The swelling frequently renders it difficult to perceive the other signs of fracture and care must always be taken not to mistake the lesion for a less serious injury

DEFORMITY or alteration in the shape of the limb may be due to transverse or longitudinal displacement of the fragments The deformity results from three factors —The direction of the violence the weight of the limb and the contraction of the muscles

Transverse Displacement results in alteration of the shape of the part

CHAPTER 31

FRACTURES, DISLOCATIONS AND SPRAINS

FRACTURES

Definition A fracture is a separation of a bone into two or more pieces as a result of violence

Causes A bone may be fractured by direct or indirect violence or by muscular contraction

DIRECT VIOLENCE The fracture occurs at the spot at which the force is applied *e g* a fracture of the tibia when the leg is run over by the wheel of a car or hit by a bumper bar

INDIRECT VIOLENCE The bone is fractured at some distance from the spot at which force is applied, for example a fall on the outstretched hand may cause a fracture of the clavicle

MUSCULAR CONTRACTION A bone is occasionally broken by the violent contraction of the muscles attached to it This is especially met with in the case of the patella, where from the sudden violent muscular contraction to avert a fall, the bone is caught at a disadvantage and fractures against the femur

When, owing to disease a fracture is brought about by violence inadequate to cause a fracture in a healthy person, it is termed a *spontaneous or pathological fracture*

Varieties Fractures are classified in various ways as regards the fracture, its extent or direction or as regards the soft parts, into simple and compound Fractures are also divided into complete and incomplete according to whether the continuity of the bone is entirely interrupted or not

COMPLETE FRACTURE In a complete fracture the bone may be snapped directly across (transverse fracture) or it may be broken in a slanting fashion (oblique or spiral fracture) Complete fractures may be further subdivided into —

Single or Multiple Fractures depending on whether one or more than one fracture has taken place

Comminuted Fractures where one or both of the bones is broken up into several pieces

Impacted Fractures When one end of a broken bone is driven into the other so forcibly that the two become firmly united the fracture is said to be impacted It is caused by the force that fractures the bone still continuing and before the two ends of the bone can escape one is firmly driven into the other

Complicated Fracture A fracture is said to be complicated when

injury an irregular cavity is formed round the two ends of the bone This cavity contains blood clot and serum and its walls consist of the lacerated soft tissues which are very oedematous and infiltrated with small round cells owing to the traumatic inflammation

STAGE II During the second week the small round cells phagocytic cells and new capillaries invade the blood clot and convert it into granulation tissue The ends of the bones are now connected by a mass of granulation tissue which not only surrounds the fractured ends but also passes up the medullary canal on either side for a short distance so that the ends of the bone are completely embedded in it

Stage III Owing to the deposit of lime salts in the granulation tissue it gradually becomes ossified, between the third and the eighth week to form provisional callus

For descriptive purposes the provisional callus is usually divided into—the *external callus* which surrounds the ends of the bone the *internal callus*, which not only seals but also connects the two medullary cavities and the callus between the external and the internal callus which is designated *intermediate callus*

STAGE IV If the apposition is good, the external and internal callus becomes gradually absorbed and the intermediate callus is converted into hard compact bone and ultimately the architecture of the bone may be so completely remodelled that it may be difficult to tell where the fracture has taken place

The conversion of the intermediate into the permanent callus may take many months but eventually it is found to consist of compact bone almost identical with that of the original shaft

On the other hand if the apposition of the two fragments is faulty a large amount of provisional callus will persist and will be converted into compact bone

The time taken over these various stages is extremely variable and depends upon the age and general condition of the patient the size and nature of the bone, and the type of fracture

The average times for firm union and convalescence after simple fracture of the individual bones may be tabulated as follows —

	Firm Union	Ability to Return to Work
Clavicle	5–6 weeks	6–8 weeks
Humerus	6–8 weeks	8–12 weeks
Forearm	4–6 weeks	6–8 weeks
Carpal and Metacarpal	3–4 weeks	4–6 weeks
Phalanges	2–3 weeks	4–6 weeks
Rib	3–4 weeks	4–6 weeks
Femur	2–3 months	6–12 months
Tibia and Fibula	7–8 weeks	3–4 months
Fibula (alone)	4–5 weeks	5–6 weeks
Tarsus and Metatarsus	3–4 weeks	4–6 weeks

In the case of compound fractures the time of union and the period of convalescence will be greatly delayed

Longitudinal Displacement results in *Shortening* *i e* the contracting muscles and the fracturing force commonly cause the broken ends to over ride, and they thus produce shortening of the fractured part

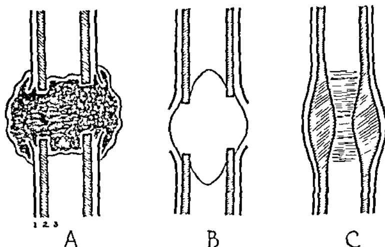


FIG 321 *1* Periosteum 2 Cortical bone and 3 Medulla and cancellous bone

The stages of union of a fracture —*A* The fractured ends of the bone surrounded by blood clot *B* The blood clot replaced by provisional callus which is soft vascular and contains numerous bone and other cells and *C* The bone ends united by bony callus The medullary portion of this callus is gradually absorbed and replaced by medulla and cancellous bone At the same time the outer surface of the bony callus is absorbed so that the bone is being reshaped

ABNORMAL PASSIVE MOBILITY The parts bend where they should not and movement can be distinguished at the seat of the fracture

LOSS OF POWER OR LOSS OF FUNCTION The inability to use the broken limb is especially marked when the portion of the limb affected only contains one bone *e g* the femur or humerus but where there are two bones as in the leg or forearm the loss of power may not be so apparent if only one is broken

CREPITUS By crepitus is meant the sensation of grating produced when two rough ends of the bone rub together

This sign should only be sought for by the surgeon but the nurse frequently hears the grating of the bones when the surgeon is reducing the fracture This sign is absent of course if the fracture is impacted

Union of Fractures As with the healing of aseptic wounds certain stages can be determined in the union of a bone (Fig 321) For descriptive purposes this union of bone is usually divided into four stages —

I Stage of blood clot,
II Stage of granulation tissue
III Stage of callus and
IV Stage of ossification

STAGE I Owing to the extravasation of blood at the time of the

When putting on a clean nightdress etc the bad side must be attended to first and conversely in taking off clothing the good side must be attended to first

Cleansing the Patient After the patient who is not suffering from shock is safely in bed and undressed he may be washed The injured limb should be shaved, well washed with soap and water, then painted with surgical spirit and dried This helps prevent infection of any blebs that may arise and also guards against the irritation of the surface of the skin which is often so distressing

The pressure of the bedclothes can be avoided by placing a cradle over the seat of the fracture

Reduction of the Deformity As mentioned above the causes of the deformity are the fracturing force directly displacing the ends of the bones muscular spasm pulling on one or both fragments and gravity These factors although quite distinct, usually act together but the muscular spasm is generally predominant

Relaxation of the muscular spasm can be obtained by anæsthetizing the patient or applying weight and pulley extension until the muscles are tired

The usual procedure is to place the patient under an anæsthetic and then set the fracture by opposing the smaller to the larger fragment In many simple fractures injection of 3 or 4 drachms of 2 per cent procaine hydrochloride in Normal saline into the hæmatoma between the fragments not only relieves muscular pain but may allow painless reduction

Fixation of the Fragments The object of a fixation apparatus is to prevent a recurrence of the deformity caused by the muscular contraction or the action of gravity, and to prevent pain from movement of the fragments

Muscular spasm may be overcome permanently by relaxation, *i e* by placing the limb in such a position that the principal muscles are relaxed or by applying weight and pulley extension in the opposite direction to the pull of the muscles Thus, when the deformity has been overcome by manipulation some form of retentive apparatus is applied to maintain the fragments in the correct position while union proceeds

Even if reduction appears to be satisfactory, confirmation should be obtained by radiological examination and with many fractures *e g* Colles fracture, it is necessary to repeat this at intervals to ensure that the position is maintained

The retentive apparatus should include the joint above and below the fracture and should not only fix the fragments but should whenever possible, allow massage and movements of other joints The forms of retentive apparatus in common use are —

(i) *Splints* Splints are made of various substances such as wood

Treatment of Fractures For descriptive purposes the treatment of fractures may be divided into the Temporary or First Aid, and the Permanent treatment

TEMPORARY TREATMENT The object of temporary or first aid treatment is to prevent movement of the fractured parts by the application of temporary splints, until the fracture can be 'set' This temporary splinting prevents further injury to the soft parts and unnecessary pain

The fractured parts should be securely fixed by means of temporary splints which can be improvized if necessary from any rigid material (*e g* a stick or umbrella) but they must be sufficiently firm to prevent their giving' when stress is put upon them These splints should extend beyond the joint above and below the fracture They are padded with towels straw clothing etc and are bound to the limb by means of handkerchiefs belts neckties etc

No attempt should be made to move a patient until the fractured limb has been securely immobilized by means of temporary splints In fractures of the upper extremity the elbow should be flexed, splints applied, and the arm supported in a sling

PERMANENT TREATMENT consists of three steps —Firstly *reduction of the deformity* when the fractured ends are replaced in their normal position secondly *fixation of the fragments* so as to prevent a recurrence of the deformity thirdly *restoration of function* by the use of massage and movement

Preparation of " Fracture Beds Beds used for nursing patients with fractures should be covered with a firm mattress preferably of horsehair, and should be narrow so that the patient can be attended to from either side In fractures of the lower extremity or the spine the bed should be prevented from sagging by inserting long wooden boards (known as fracture boards) under the mattress to render it more rigid it is then called a fracture bed

If the patient is very shocked he should not be washed and undressed until his condition has been improved

Undressing the Patient In the case of fracture of the lower extremity the trouser of the injured leg should be split up the outside seam The braces are then unfastened both back and front and the cut trouser leg is drawn inwards with the greatest care, from under the whole length of the injured leg The boot and sock can usually be carefully drawn off without disturbing the fractured parts

On the other hand if the upper extremity is fractured the sleeve should be carefully removed from the uninjured side first but if this cannot be done without much pain the outside seams of the coat waistcoat and shirt must be split A nurse should never risk increasing the injury by refraining from cutting the clothes, but on the other hand they must not be needlessly sacrificed

both of which may be difficult and at the same time to replace and fix the bony fragments in correct alignment

Hæmarthrosis Hæmarthrosis (hæmorrhage into the joint) is likely to occur when the fracture extends to the joint surface of a bone

DURING THE COURSE OF TREATMENT—*Delirium Tremens* frequently follows a fracture in an alcoholic subject for the shock of the accident combined with the absence of alcohol and the complete change of mode of life may give rise in the course of a day or two to a typical attack of delirium tremens The early signs are tachycardia sleepless ness and loss of appetite but soon there are hallucinations of sight and hearing attempts to pull off the bandages and splints and to get up out of bed In addition there is the tremulous condition of the hands and tongue from which the disease derives its name From time to time outbursts of maniacal excitement occur during which the patient tries to escape from imaginary adversaries and suicidal tendencies are not uncommon

The correct treatment is to induce sleep and to this end twenty grains of chloral hydrate with forty grains of potassium bromide should be given at least every four hours until the patient is asleep

Liquid nourishment should be given frequently

Owing to the frequent development of suicidal tendencies a nurse must be constantly in attendance In the milder cases one nurse may be able to restrain him sufficiently, but in the more severe cases the patient should be secured with a ' straight jacket

Lung Complications Many people when confined to bed and lying on their backs have difficulty in coughing up the mucus from the small bronchi and in old people the poor circulation may lead to congestion of the bases of the lungs and broncho pneumonia Hence all fracture patients should be propped up and saliva aspirated if necessary In the case of elderly people early ambulation may be essential

Fat Embolism This is due to setting free the fat in the medulla and cancellous ends of the bone After the fat is forced into the circulation by the pressure of the extravasated blood it becomes arrested in various organs of the body and produces infarcts

The capillaries and terminal arteries in the lungs become plugged with liquid fat and the patient complains of shortness of breath which is soon followed by cough pleural pain and rusty expectoration

When the emboli pass through the lungs they may lodge in the brain and produce delirium vomiting convulsions etc and in rare instances oil globules are even found in the urine

Bed Sores are liable to occur in elderly people especially when they are suffering from fractures which enforce a recumbent position

Ischæmic Paralysis or Volkmann s Contracture is usually seen in connexion with forearm fractures and consists of a gradual contracture

metal poroplastic felt, etc, and according to their function may be classified into three groups—

Simple Fixation Splints, which simply retain the fragments in their normal position after they have been set

Splints aiding in overcoming Deformity Here in addition to simple fixation the shape of the splint largely determines the position of the fragments

Splints combining Simple Fixation with Extension, e g Hodgen's Splint

(ii) *Casings* or bandages etc impregnated with certain chemicals, having the property of setting or hardening and thus forming a firm, rigid support, *e g* Plaster of Paris, waterglass etc (See Chapter 30)

(iii) *Wiring Screwing and Pegging the Fragments together* There are many fractures in which it is impossible to obtain or maintain accurate apposition of the fragments by the above means *e g* in the case of fractured patella where the pull of the quadriceps femoris muscle is so great In these cases operation will be necessary After the fracture is reduced it is fixed by means of metal wire, nails or pegs Lane s plates Kuntscher s intramedullary nails (Fig 304) or Lane s plates (Fig 305) Following the application of these internal splints external splinting is still required

Massage and Passive Movements Massage is very efficacious in removing the extravasated blood preventing atrophy and avoiding the formation of adhesions in tendon sheaths and joints It is usually started about the third day

Passive movements are generally commenced about the seventh to the tenth day and on about the fourteenth day active movements may be instituted

The aim of treatment should be a complete return of function as soon as possible

Complications of Simple Fractures These can be subdivided into *two groups according to whether they occur at the time of the accident* or during the course of the treatment

AT THE TIME OF THE ACCIDENT—*Shock* The amount of shock associated with fractures is extremely variable and if severe should be treated on the lines already laid down in Chapter 17

Injury to the Blood Vessels and Nerves of the part The fractured ends may injure the blood vessels nerves muscles etc, in their vicinity and may give rise to internal hæmorrhage gangrene or paralysis of the injured parts

Dislocation Dislocation of a joint near the fracture may accompany fractures of the upper end of the humerus of the base of the first metacarpal etc and considerably adds to the problems of treatment It is necessary to reduce the dislocation and to prevent its recurrence

both of which may be difficult and at the same time to replace and fix the bony fragments in correct alignment

Hæmarthrosis Hæmarthrosis (hæmorrhage into the joint) is likely to occur when the fracture extends to the joint surface of a bone

DURING THE COURSE OF TREATMENT —*Delirium Tremens* frequently follows a fracture in an alcoholic subject for the shock of the accident combined with the absence of alcohol and the complete change of mode of life may give rise in the course of a day or two to a typical attack of delirium tremens The early signs are tachycardia sleeplessness, and loss of appetite but soon there are hallucinations of sight and hearing attempts to pull off the bandages and splints and to get up out of bed In addition there is the tremulous condition of the hands and tongue from which the disease derives its name From time to time outbursts of maniacal excitement occur during which the patient tries to escape from imaginary adversaries and suicidal tendencies are not uncommon

The correct treatment is to induce sleep and to this end twenty grains of chloral hydrate with forty grains of potassium bromide should be given at least every four hours until the patient is asleep

Liquid nourishment should be given frequently

Owing to the frequent development of suicidal tendencies a nurse must be constantly *in attendance* In the milder cases one nurse may be able to restrain *him sufficiently* but in the more severe cases the patient should be secured with a straight jacket

Lung Complications Many people when confined to bed and lying on their backs have *difficulty* in coughing up the mucus from the small bronchi and in old people the poor circulation may lead to congestion of the bases of the lungs and broncho pneumonia Hence all fracture patients should be propped up and saliva aspirated if necessary In the case of elderly people early ambulation may be essential

Fat Embolism This is due to setting free the fat in the medulla and cancellous ends of the bone After the fat is forced into the circulation by the pressure of the extravasated blood it becomes arrested in various organs of the body and produces infarcts

The capillaries and terminal arteries in the lungs become plugged with liquid fat and the patient complains of shortness of breath which is soon followed by cough pleural pain and rusty expectoration

When the emboli pass through the lungs they may lodge in the brain and produce delirium vomiting convulsions etc and in rare instances oil globules are even found in the urine

Bed Sores are liable to occur in elderly people especially when they are suffering from fractures which enforce a recumbent position

Ischæmic Paralysis or Volkmann s Contracture is usually seen in connexion with forearm fractures and consists of a gradual contracture

of the flexor muscles of the forearm whereby the fingers become flexed and clawed It is due to anæmia of the muscles produced by too tight bandaging or splinting or by pressure on their arteries by bony fragments or hæmatomata The treatment consists of relief of the pressure massage, manipulation and in rare instances open operation later to lengthen the tendons

Myositis Ossificans Ossification of hæmatomata in the attachments of muscles to bones is likely to accompany fractures when immobilization is not complete and it is especially common in the brachialis muscle when the lower end of the humerus is fractured

Contractures Shortening and contraction of strong groups of muscles may develop at the expense of weaker groups if such is permitted For example, unless the foot is supported in a dorsiflexed position the contraction and shortening of the strong muscles of the calf (together with the action of gravity) will result in a foot drop and a stretching of the weaker muscles of the anterior aspect of the lower leg

Arthritis If there has been considerable damage to the articular cartilage at the time of the injury or if the fracture extends into the joint an arthritis will usually follow This also occurs when the fracture has been allowed to unite in a faulty position so that abnormal strains are thrown on the joints above and below the fracture

Malunion consists of union of the fragments in a faulty position for example at an angle to each other instead of in a straight line It may be due to imperfect reduction incomplete fixation or to yielding of the callus owing to too early removal of the splints

Delayed Union consists of the failure of a bone to unite as quickly as normal and is due generally to imperfect reduction to imperfect fixation of the fragments or in some cases to constitutional disease In cases of delayed union prolonged fixation of the fragments will be necessary

In addition to being a supporting structure the skeleton is also a reservoir for the elements calcium and phosphorus

Parathyroid secretion (parathormone) controls the absorption of calcium from the intestine its deposition and removal from the bones and its excretion in the urine but the control of the parathyroids over calcium metabolism is itself under the influence of various factors such as the calcium and Vitamin D intake in the diet

Although the blood calcium is not altered in the formation of callus—the repair of a fracture being purely a local change—therapeutic doses of the above substances may be administered to aid the passage of calcium from the blood into the provisional callus

Nonunion or *Ununited Fracture* Sometimes the fragments fail to unite because a piece of muscle or other tissue is interposed between the fractured ends or because there is inefficient fixation of the end

This may be due either to nonformation of callus (absolute nonunion) or to the conversion of callus into fibrous tissue (fibrous union) instead of true bone Sometimes, however, a false joint or pseudarthrosis is formed between the ends of the bones and then the fibrous union is merely represented by the capsule of this false joint

Ununited fractures usually require treatment by operation

Disunion of a Fracture Here owing to debilitating disease the callus which was firmly uniting the fractured ends becomes absorbed and the fragments again separate

Special Fractures FRACTURE OF THE LOWER JAW Owing to the fact that the mucous membrane of the mouth is generally torn these fractures are compound as a rule and therefore the hygiene of the mouth must be attended to in a similar manner to that described under mouth operations

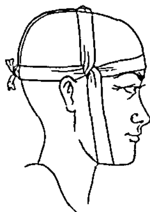


FIG 322 Barrel bandage for a fractured lower jaw

The fragments are usually reduced by manipulation and then fixed by special splints applied to the teeth by other special splints inserted into the bone or by a barrel bandage

The patient is fed by means of a tube passed between the teeth or behind the last tooth It is essential to keep the mouth clean, and this is easier in the cases in which a splint is used than in those in which immobilization is obtained by bandaging the jaw

FRACTURE OF THE CLAVICLE The deformity is overcome by manipulation and may be fixed by holding the shoulders backwards and upwards by a tight figure of eight bandage Such a bandage should be inspected and if necessary adjusted daily so that it is kept tight and the reduction of the fracture maintained

Before the bandage is applied the axillæ and shoulders should be cleansed with soap and water and spirit and then powdered

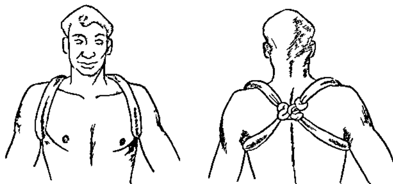


FIG 323 Front and back views of a figure of 8 bandage for a fractured clavicle

To prepare the figure of eight ' bandage a tube of stockinette about five and a half feet long is taken and a piece of cotton wool taken freshly from a roll also about five and a half feet long is inserted into it The stockinette is then pulled tight from both ends so that

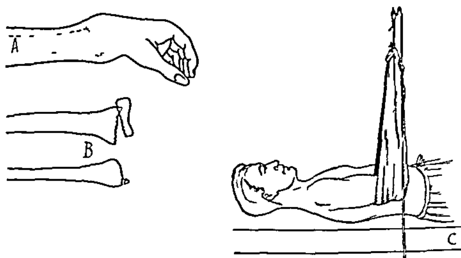


FIG 324 Diagram of a Colles fracture of the lower end of the radius showing (A) the typical dinner fork deformity as seen from the side and (B) the sites of the two fractures in the lower ends of the radius and ulna (C) a method of supporting the forearm in a piece of cloth from an intravenous stand in order to overcome the swelling due to the collection of fluid in the tissues

a tube about two inches in diameter is obtained This is used as the figure of eight and is tied posteriorly The cotton wool is removed from the portion of the bandage in which the knot is placed The knot should be flattened so that it will not cause inconvenience to the patient in bed

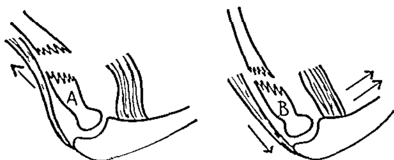


FIG 325 Diagrams of a supracondylar fracture of the humerus
The lower fragment of the humerus (A) is pulled backwards and upwards by the pull of the muscles as indicated by the arrow To correct the deformity and restore the lower fragment of the humerus to its normal position (B) traction is applied (in the direction of the single arrow) and the elbow is flexed (as indicated by the pair of arrows)

Instead of the stockinette and wool a flannel bandage may be used but it is less easy to adjust unless it is completely removed, and it is not as comfortable The figure of eight may also be made with plaster of Paris bandages if the axillæ are first well padded with cotton wool

FRACTURED RIBS If there is no obvious injury to the lungs the ribs on the affected side of the chest are usually fixed in the position of expiration by means of adhesive strapping applied to the chest wall Unless there are other injuries the patient is not confined to bed

If there is any injury to the lung, as shown by cough and the spitting of blood strapping should be avoided owing to the risk of driving the fragments further into the lung The patient with fractured ribs is then nursed propped up in bed

FRACTURE OF THE PELVIS Fractures of the pelvis are frequently associated with serious injury of the bladder and urethra, and in confirming the diagnosis of such additional injuries the surgeon will usually pass a catheter If such injuries do exist, operative repair must be carried out

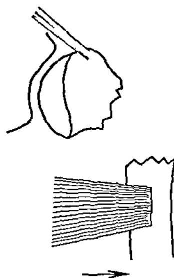


FIG 326 Diagram showing a fracture through the surgical neck of the humerus with the head of the humerus abducted by the pull of the supraspinatus muscle The lower fragment is pulled inwards by the pectoralis muscle

To correct the deformity the shaft of the bone is moved outwards as indicated by the arrow and then it is also brought into the fully abducted position It is usually retained in this position by means of an abduction frame but occasionally a splint is used or a plaster cast is applied to the arm and chest

These patients must always be moved with the greatest care otherwise further damage may occur

Unless there is gross displacement or mobility of the fragments a patient with a fractured pelvis is treated on his back in bed A tight binder around the pelvis may increase his comfort If one side of the pelvis has ridden upwards on the other traction will be applied to the legs In some patients with severe injuries there may be a feeling of insecurity in which case a sling passed around the pelvis may be of great value

In these patients the skin over the sacrum is very apt to form bed sores and to prevent this the back must be rubbed once or more

times daily If a divided mattress is not available, the patient must be lifted "in one piece" by two nurses on either side whilst the rubbing is being carried out Similarly for defæcation the patient will be lifted and supported on a bed pan

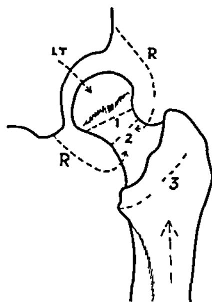


FIG 327 Diagram of the hip joint showing the three common sites for fracture of the upper end of the femur 1 Sub capital 2 Transcervical and 3 Per trochanteric

The blood supply of the head of the femur passes mainly along the neck of the bone and through the retinacula (R) Very little of the blood supply passes through the ligamentum teres (LT) Thus a subcapital fracture deprives the head of the bone of most of its blood supply a transcervical fracture deprives the head of the bone of a variable amount of its blood supply depending on the degree of involvement of the retinacula whereas a pertrochanteric fracture interferes very little with the blood supply of the head of the bone The rate of healing of a fracture depends to a large extent on its blood supply

FRACTURED SPINE The treatment is described in Chapter 33

FRACTURED PATELLA Nowadays fractures of the patella are usually treated by open operation, the bony fragments being wired together or part or whole of the bone removed As soon as the stitches are removed massage and passive movements should be instituted

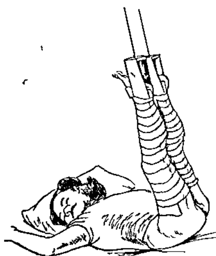


FIG 328 Bryant s extension for a fractured femur in an infant The ropes pass over pulleys to weights which are just sufficient to raise the buttocks off the bed The adhesive surface of the strapping near the ankles is covered with other strapping so that it will not adhere to the malleoli

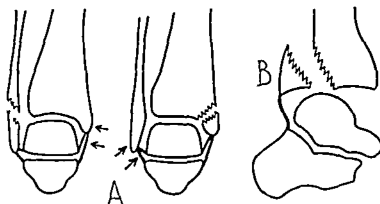


Fig 329 Diagrams of Potts fracture dislocations of the ankle in which either the opposite ligament is torn or a chip is pulled off the opposite malleolus as indicated by the arrows

A Coronal sections B Sagittal section showing the separated posterior portion of the tibia the so-called third malleolus which is also fractured in severe cases



Fig 330 Photograph of an X ray showing a posterior fracture dislocation of the ankle

FRACTURED CARPAL NAVICULAR (SCAPHOID) As the blood supply to part of the bone is often damaged by the fracture, union is slow and immobilization may be required for many months

Compound Fractures Compound fractures are more serious than simple fractures owing to the danger of hæmorrhage and to the risk of infection of the wound and the broken ends of the bone Each case should receive prophylactic doses of tetanus antitoxin (3 000 units) and polyvalent gas gangrene antitoxin (10 000 units) and should start a prophylactic course of penicillin *e g* 100 000 units intramuscularly every three to six hours

The treatment of a compound fracture is the same as that for a simple fracture except that the wound has to be cleansed and rendered aseptic so that it can heal by primary union—in other words the aim is to convert the compound fracture into a simple fracture With this object the patient should be anæsthetized and the limb shaved and thoroughly cleansed The edges of the wound excised all dirt foreign bodies loose bone fragments, etc removed and bits of torn muscle are cut away until healthy unlacerated tissues are reached Suitable antiseptics are then applied to the whole wound in a manner similar to that described for soiled or infected wounds (See Chapter 6)

After the debridement is completed the wound should be insufflated with penicillin and sulphanilamide or a similar powder

The fracture is then reduced and fixed with a retentive apparatus as in the case of simple fracture If the wound has been rendered aseptic it should be sutured the stitches are interrupted and spaced sufficiently apart to permit of a certain amount of drainage and yet they should accurately approximate the tissues A few strands of silkworm gut may be inserted to serve the double purpose of draining the wound and providing a tell tale as to the bacteriological flora it may contain they are removed at the end of the second or third day and may be cultured to determine the type of infecting organism and whether the wound may remain closed or should be re opened If cultures reveal sensitive micro organisms the appropriate antibiotic will be given If gross suppuration occurs it will be necessary to re open the wound and occasionally even to irrigate it

In patients with compound fractures and in whom there is extensive injury to the soft tissues or in whom the skin margins can not be apposed the Winnett Orr method of treatment of Immobilization and Rest may be used This has been summarized by its distinguished originator thus —

Immobilize patient at once in the best position possible on operating table

Do a thorough debridement

Pack entire wound open with sterile Vaselined gauze, using no sutures or drainage tubes

Apply an extensive well fitting plaster of Paris cast

Do not disturb the cast the wound, the dressings or the injured part except for definite complications (In the first instance the dressings are usually left untouched and undisturbed for two or more weeks)

The later dressings should be as infrequent as the early ones An anæsthetic may be required for some of the dressings

Although a closed plaster favours connective tissue growth it does not appear to favour epithelial regeneration Hence after bone repair has been assured the limb should be taken out of the plaster and the wound treated in the usual manner and with chemotherapy and antibiotics until such time as it is ready for skin grafting

Owing to the obnoxious smell in some patients treated by the Winnett Orr method these patients should be nursed in the open air on a balcony or the limb placed in a special deodorizing bag made of filter cloth

In obviously septic cases the tissues which have already developed protection should not be excised but all dead and foreign material must be removed, and free and efficient drainage afforded In these cases it is sometimes advisable to employ the Carrel Dakin method This method of using many small tubes and intermittent irrigations was widely used in the days of the 1914–18 war and it still has a place (albeit a small one) in the management of septic compound fractures

Special Complications of Compound Fractures

Osteomyelitis An acute osteomyelitis may develop and this may lead to a pyæmia which endangers the patient s life or it may lead to necrosis of the bone With treatment the acute osteomyelitis may be cured or it may become chronic

Any of the *Complications of Sepsis* such as embolic or metastatic abscesses or septicæmia may occur if free drainage is not established

Delayed Union

Nonunion

Primary or *Secondary Hæmorrhage*

DISLOCATIONS

Definition A joint is said to be dislocated when an articular end of one of the bones forming it is out of place

Cause Although the term dislocation is commonly applied to the traumatic displacement of one or more bones from a joint it must not be forgotten that congenital and pathological dislocations also exist

TRAUMATIC DISLOCATIONS like traumatic fractures may arise from direct or indirect violence or even from excessive muscular contraction

PATHOLOGICAL DISLOCATIONS follow on the excessive distension or

destruction of a joint from disease, for example, the later stages of tubercular disease of the hip joint

CONGENITAL DISLOCATION is a term applied to an error of develop ment whereby a joint is defective at birth This most often occurs at the hip joints (and in girls more than boys)

Congenital dislocation of the hip (CDH) requires reduction and fixation in plaster for some months during infancy

Varieties *For the purpose of description different types of dis* location are given names similar to those applied to fractures

AN INCOMPLETE DISLOCATION OR SUBLUXATION is the name given when the bony surfaces are only partially separated

A COMPLETE DISLOCATION OR LUXATION is applied where the articular surfaces are completely separated from one another or a

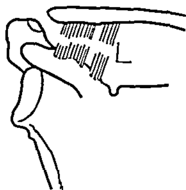


FIG 331 Diagram showing a dislocation of the acromioclavicular joint The coraco clavicular ligament (L) is torn and the articular surfaces are separate

hole is torn in the joint capsule or the capsule is torn from the margin of the joint cavity thus allowing the end of the bone to escape from the joint

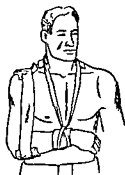


FIG 332 For the treatment of a dislocation of the acromioclavicular joint a collar and cuff sling is used and one piece of adhesive plaster is applied around pads on the end of the clavicle and around the elbow By this means the weight of the arm is transmitted to the outer end of the clavicle and this helps pull it back into place

A COMPOUND DISLOCATION is one in which the skin has been ruptured and a wound leads into the joint

A COMPLICATED DISLOCATION is so called when in addition to the dislocation important structures such as blood vessels nerves or viscera have been injured

When a dislocation is complicated by a fracture of one or both of the bones involved the condition is termed a ' fracture dislocation '

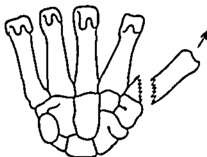


Fig 333 Diagram of the fracture dislocation of the base of the first metacarpal which is known as Bennett s fracture For its reduction and fixation traction is applied in the direction of the arrow for at least a few weeks

Slipped Epiphysis or adolescent coxa vara In boys about 10 or 12 years old the epiphysis of the femoral head may be partially detached from the femoral neck, which is then displaced slightly upwards and backwards

To overcome the deformity (so that growth of the bone will be normal again) it is necessary to confine the patient to bed and to apply traction to the legs

Signs The signs of a dislocation are as follows —

The Signs of Local Trauma such as pain, bruising and swelling These occur because of the laceration of the tissues and the extravasation of blood into them

Deformity or alteration in the shape of the limb

Diminished Mobility and Impairment of the Function of the Joint The limb tends to take up a fixed position and any attempt at movement is resisted by the tense ligaments and muscles

Alteration of the Length of the Limb Lengthening may be present in one form of dislocation and shortening in another

The signs are somewhat similar to those found in cases of fracture but the main points of distinction are —The lesion lies in the vicinity of a joint the limb presents restricted instead of increased mobility the ends of the bones are smooth and round not sharp or angular and no crepitus can be elicited

Treatment of Dislocations Temporary Treatment The object of first aid treatment is to prevent movement of the injured limb by the application of temporary splints until the dislocation can be reduced thus avoiding any unnecessary injury to the soft parts

The joint should be fixed in whatever position gives most ease to the patient and cold in the form of evaporating lotions may be applied

Permanent Treatment The methods of removing clothes from an injured limb were described when dealing with fractures An anæsthetic should be administered and the limb directed by a combination of manipulation and manual extension so that the bone retraces its course through the rent in the capsule and comes back

to its normal position It is then kept at rest by means of some retentive apparatus until the rent in the joint capsule has healed In the upper extremity a bandage and sling are usually applied The lower extremity is covered with a fracture cloth and immobilized between sandbags for an injury at the hip joint If it is at the knee or ankle joint, a plaster of Paris casing is usually applied after reduction because in these joints dislocation is always associated with consider able tearing of the ligaments Early movement will cause stretching of healing ligaments and is to be discouraged after most dislocations

Massage may be commenced immediately after reduction, but passive movement should be postponed for a week or ten days

SPRAINS

Definition An articular sprain is one where as a result of some external violence usually a sudden wrench the ligaments of a joint are over stretched or torn across but where no gross lesion of the bone and no dislocation are to be found

Signs The signs are pain and some loss of function of the joint together with a variable degree of swelling and bruising from the extravasation of blood

Treatment Treatment consists mainly in the application of firm elastic pressure to the joint which not only secures rest of the joint and checks hæmorrhage but promotes absorption of the extravasated blood Thick layers of cotton wool are wrapped round the joint and over this a roller bandage is firmly applied in such a direction that the sprained ligament is relaxed This bandage should be readjusted twice in each twenty four hours In some situations *e g* the lateral ligament of the ankle the injection of a local anæsthetic agent into the site of the sprain considerably relieves the pain

Massage and passive movements are usually commenced on the third day after the sprain but active movements should be postponed for about a week Sprains should not be treated by fixation of the joint with rigid splints or appliances

CHAPTER 32

AMPUTATIONS AND OPERATIONS ON JOINTS

AMPUTATIONS

AMPUTATIONS are defined as operations in which a limb or part of a limb is removed from the rest of the body They include not only amputations proper where part of the limb is removed after division of bone, but also disarticulations where the section is through one of the joints without the division of bone

Preparation for Operation For operations made under aseptic conditions the preparation does not differ from that already described for operations in general An extensive area of skin should be purified, and when the sterilized dressing is removed on the operation table the limb above and below the site of incision should be wrapped in sterilized towels

In accident cases the preparation of the operation area should be carried out in the theatre The limb is dry shaved the skin cleaned with ether soap and ether and then painted over with iodine solution The wound is washed out with an aqueous solution of flavine 1 1 000

Types of Operation Amputations may be divided into two groups (1) *The Open Method* where the wound is left open and allowed to heal by granulation and (2) *The Closed Method* in which flaps are approximated at the time of the original operation (Primary Suture) or after several days (Delayed Primary Suture)

In amputations performed for septic wounds and more especially if there is a possibility that the stump will become infected it is usually wise to leave the wound unsutured An open wound is thus left which is very favourable for the subsequent control of sepsis and which greatly diminishes the risk of secondary hæmorrhage The wound heals by granulation and ultimately a stump as serviceable as that achieved by primary union is attained

Since the introduction of penicillin and other antibiotics it has been possible to close the wound in a greater number of cases

In all amputations care must be taken to control the bleeding during the operation and this may be carried out by previous exsanguination of the limb by elevating it for two to three minutes and then applying a tourniquet Should the tourniquet have to be applied in the vicinity of the operation area it should of course be sterilized It is also advisable to protect with a sterile towel the skin over which the tourniquet is applied In cases where it is inadvisable to apply a

tourniquet the main artery may be compressed by the fingers of an assistant at a pressure point higher up the limb

Position during the Operation For amputation through the thigh the patient should be rolled over towards the opposite side and supported there by sandbags under the buttocks For amputations below the knee a similar position may be adopted or the patient may be placed face downwards on the operating table with the knee bent to a right angle Such positions greatly facilitate the incision on the back of the leg

After-treatment

CLOSED OPERATION *Position and Immobility of the Stump* After the operation the limb should be immobilized in order to avoid painful spasmodic contractions of the muscles of the stump The bandage retaining the dressing should be applied in such a way that it presses the flaps down over the end of the bone and at the same time uniformly compresses and steadies the muscles

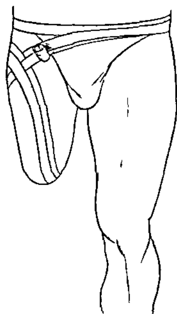


FIG 334 The method of application of a bandage to an amputation stump of the thigh The crossings of the bandage are so placed that it does not cause any flexion of the hip joint

The bandage should be applied to an amputation stump in the thigh so that there is no tendency to flex the hip joint the turns of the bandage should cross each other on the outer side of the leg

A splint may be applied to the stump in order to prevent starting pains The foot of the bed is raised to elevate the stump but it should not be supported on a pillow as this may lead to contraction of the flexor muscles of the hip A cradle is placed over the stump and the bed clothes so arranged that the dressings can be examined without disturbing the patient

Drainage As a considerable amount of oozing may take place after amputations drainage is usually provided otherwise the flaps may become separated by blood clot

Any drainage tube should be removed on the third day If infection has occurred a sufficient number of stitches should also be removed to allow the free escape of the pus

Occasionally it is necessary to remove all the stitches at an early stage because of the severity of the infection

Stitches The stitches are usually removed about the tenth day,

and then broad strips of adhesive plaster are sometimes applied over the stump to prevent stretching of the scar

Massage and Movement When healing is complete systematic massage should be instituted and the adjacent joints should be subjected to progressive passive and active movements

Artificial Limb For a time after the healing first appears to be complete, some temporary induration of the flaps remains, and it is inadvisable to fit an artificial limb until this has subsided To encourage absorption the stump should be firmly bandaged A crepe bandage should be firmly applied and worn continuously both day and night This will also considerably help towards securing a useful taper shaped stump

In addition regular and systematic exercise of the remaining muscles of the stump should be instituted in order that their tone may be maintained

Generally speaking as soon as the wound is healed the patient should perform active exercises against resistance for twenty minute periods two or three times a day In practice it has been found that an elastic exerciser is very efficient as it provides resistance which can be progressively increased

After three months shrinkage of the stump should have progressed sufficiently to allow an artificial limb to be fitted

In amputations below the knee joint the stump fits into a bucket which by means of a hinge at the level of that joint is united to a leather socket—known as the lacer —which encases the thigh thus the movements of the lower part of the prosthesis are controlled directly by those of the knee

If the amputation has been performed above the knee, the stump fits directly into a thigh bucket and control of the knee joint is effected either by an attachment to a pelvic band or by an arrangement of braces across the body and shoulders so adjusted that when the hip joint is bent forwards the knee bends back Control of the foot is always automatic The stump is protected from chafing by means of a stump sock made of firmly knitted wool care being taken that the base of this sock is not pulled tightly over the end of the stump otherwise pain and soreness will result

Modern limb factories have an instruction room containing a long narrow platform with a hand rail on either side and a mirror at each end

When the limb is first fitted the patient by the aid of the hand rail walks up and down this platform whilst an instructor demonstrates the use of the replacement and points out in the mirrors any faults that may arise in using the limb

It is essential that the patient is instructed in the correct use of his replacement otherwise he acquires faulty habits which lead not only

to pain and disability, but also to marked impairment in the efficiency of the apparatus

Many minor adjustments may be necessary before the artificial limb is satisfactory

In the majority of cases shrinkage of the stump occurs after some months and the artificial limb becomes loose This can be remedied by the use of additional stump socks and subsequently by the provision of a new bucket

The first replacement usually lasts for one to two years but for subsequent ones the life may be extended from three to five years or even longer

The average weight of a replacement should not exceed five pounds These replacements are usually made of willow covered by raw hide certalmid (composition) or duralumin (metal) whilst the lacer itself is usually constructed of leather or celluloid

OPEN OPERATION The after treatment of the open operation differs somewhat from that used where the closed method is adopted, more especially as regards the immobilization of the stump and its subsequent dressing

Immobilization of the Stump In operations of the open type the soft parts tend to retract and hence it is advantageous to keep them stretched by the application of extension strapping

Extension may be obtained by the weight and pulley method, or by fixation to a Thomas knee splint but it is not usually applied until the initial acute inflammation of the wound has subsided

Dressing When the stump is treated by the open method the wound is generally lightly packed with sterile gauze which is removed at the end of about forty eight hours

The treatment does not now vary from that described elsewhere for infected and septic wounds if the purulent discharge is excessive the Carrel Dakin method of irrigation may be instituted until the wound is clinically sterile Secondary suture is then performed

Complications SHOCK This is one of the chief dangers attending an amputation

HÆMORRHAGE Hæmorrhage may be primary secondary or reactionary and its treatment is the same as that already described in Chapter 16 When the patient is recovering from the initial shock the nurse must frequently inspect the dressings for signs of reactionary hæmorrhage and furthermore in those cases where sepsis is present a tourniquet should always be placed alongside the patient for immediate application in case of secondary hæmorrhage

PAIN The pain immediately after operations is usually very severe as it is due to spasm of the muscles and it should be alleviated by elevation and immobilization of the stump and if necessary by the administration of morphia

The pain occurring at a much later date is usually shooting or neuralgic in character and is due to involvement of the divided nerves in the scar, so that they are dragged upon at each movement of the stump This is now much less common than formerly due to improved operative technique and to the lessened frequency of infection in the wound

SEPSIS may lead to an adherent scar, involvement of the nerves in the scar sloughing of the flaps or necrosis of bone When the infection occurs at the time of operation a considerable amount of necrosis of skin or bone may take place and this necrosis of skin may cause the wound to remain open at some point for a considerable time

ADHERENT SCAR An adherent scar is characterized by a painful and tender scar which is very prone to ulcerate Such ulceration can generally be prevented by strict attention to the details of aseptic technique and as soon as the wound has healed, by massaging the scar for a few minutes every morning so that it becomes freely movable on the deeper structures If however the scar is already adherent it should be separated from the bone by operation and then daily massage should be instituted to prevent its again becoming adherent

PERSISTENT SINUS This is usually due to the presence of a deep stitch or ligature or a piece of necrosed bone Any of these will act as a foreign body and must be removed

CONICAL STUMP A conical stump occurs either because the flaps are cut too short or from shrinkage of the parts following septic inflammation It may largely be prevented by bandaging the stump from above downwards so as to draw down and support the muscles or by applying extension to the soft parts Re amputation is the only effective treatment once a conical stump has developed

CRUTCH PALSY When crutches are required those selected should not cause pressure on the nerves of the arm and should have cross pieces for the hands so that the weight of the body can be borne on the arms

Failure to instruct the patient in this respect causes a condition known as crutch palsy which is characterized by weakness of the extensor muscles of the fingers wrist and forearm and by wrist drop When it occurs crutches should be discontinued the hand and fingers supported and massage and electrical treatment employed for the affected muscles

OPERATIONS ON JOINTS

The chief operations performed on joints are —

Meniscectomy Removal of a damaged meniscus usually the medial from the knee joint

Arthrotomy Arthrotomy or simple incision of a joint is under taken for exploration or to establish efficient drainage in cases of suppurative arthritis

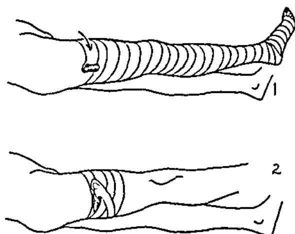


FIG 335 Diagrams showing an Esmarch s rubber bandage being applied to a limb before operation

With the leg elevated it is tightly applied from the lower end of the limb upwards the upper end is then fixed (1) and the lower part of the bandage unwound (2) In this way the limb is partially emptied of blood

Arthrectomy Arthrectomy consists in arthrotomy followed by the excision of part or whole of the synovial membrane and the removal of any foci of disease from the articular cartilages or bones It is a conservative operation and enables us to preserve joint function to a much larger extent than does complete excision At the present time the term is generally applied to the removal of tubercular lesions from a joint

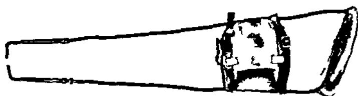


FIG 336 A walking caliper

The ring rests against the ischial tuberosity and the skin in that area requires the same detailed care and attention as in patients using a Thomas bed knee splint The straps are fixed around the knee and the divided lower end fits into holes on each side of the heel of the shoe With the length of the caliper adjusted so that the patient s heel is just out of contact with the shoe the weight is taken directly up to the ring of the caliper

Excision or Resection of a Joint is the removal of the articular surfaces of the bones entering into the formation of a joint It is

usually performed to eradicate disease processes or to overcome ankylosis of a joint

Arthrodesis is a special form of arthrectomy and consists in the complete removal of the articular cartilage of a joint with a view to securing bony fixation of the joint

The operation is performed in order to fix a joint when its muscles are paralysed or to fix a joint that is the seat of an intractable osteoarthritis

Arthroplasty is the converse of arthrodesis and aims at establishing mobility in an ankylosed joint The joint surfaces are separated and shaped then soft tissues are interposed between them with the object of imitating an ununited fracture or pseudoarthrosis

More usually the head of the femur is replaced by a mould of vitallium stainless steel or acrylic

Arthrotomy and Meniscectomy

Preparation of the Patient In all joint operations the most rigorous aseptic precautions must be observed, not only in the preparation and during the operation but also in the after treatment The development of sepsis in the wound and joint is a calamity which may lead to septicæmia or pyæmia and death or if the patient recovers to permanent stiffness of the joint These precautions must also be observed even if the joint is infected, in order that mixed or secondary infection may be prevented

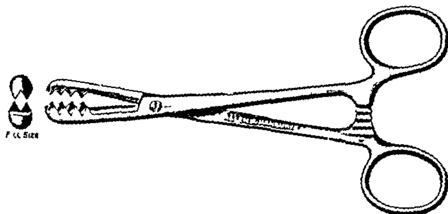


FIG 337 Martin s cartilage forceps

After treatment I ARTHROTOMY WITHOUT DRAINAGE This is similar to that described for other aseptic operations but the early institution of active and passive movements is even more important than usual

Active and Passive Movements After an operation on a joint e g the removal of an injured meniscus from the knee joint there is a great tendency towards the formation of articular adhesions and

it is of the utmost importance to commence joint movements early in order that the joint will subsequently be capable of free and painless movement Graduated daily passive movements should be commenced on the third day and after about a week a light dressing may be substituted for that originally applied and active movements begun

After the tenth day the patient should be encouraged to move this joint as much as possible and full use of the limb should be regained in about three weeks

For the first week a removable splint may be applied in order to fix the joint and avoid spasm and contraction of the muscles but thereafter it should be discontinued

Dressings At the end of the operation the dressing is covered with a layer of sterile cotton wool, and firm pressure is applied by means of a crepe bandage The sutures are removed about the tenth day when the wound is redressed

Massage Massage is very beneficial in keeping up the tone of the muscles and preventing adhesions, and it should be instituted after the second day

2 ARTHROTOMY WITH DRAINAGE In severe suppurative arthritis ankylosis is extremely liable to occur but with careful nursing the excellent functional results obtained are sometimes remarkable The main points to achieve are the early subsidence of the infection and the prevention of adhesions After the wound has healed the treatment is the same as that described for arthrotomy without drainage

Immobilization The limb may be put on a light metal splint and absolute fixation maintained for about ten to fourteen days the joint being in the most favourable position for ankylosis should that occur For the relief of pain after an operation on a joint it is sometimes the practice to apply extension so as to relieve the pressure on the articular ends of the bones

Progressive Disinfection The patient suffering with a septic arthritis will receive sulphonamides or antibiotics appropriate for the type of infecting organism and a solution of penicillin or streptomycin may be introduced into the joint at intervals The injection into the joint will be by means of a needle and syringe or, if a tube has been inserted at operation through the synovial membrane the solution will be introduced along the tube It is most important that such injections are carried out with the strictest aseptic precautions otherwise a mixed infection will occur

Movements Passive movements should be instituted as soon as the infection has been overcome but the limb should be kept in a removable metal splint until the wound has healed in order to prevent contraction of the muscles and subsequent deformity of the joint

Excision of a Joint

Preparation of the Patient The preparation of the patient is the same as that already described for arthrotomy

After treatment The after treatment varies according to whether the object of the operation is to procure a fixed or a movable joint In general it may be said that in the lower limb a fixed or ankylosed limb is desired and in the upper limb a movable joint

Ankylosed Joint

When ankylosis of a joint is desired after excision of a joint the bones must be immobilized until firm union is established between them and any movement of the bones one or another is to be avoided In certain cases with the object of obtaining absolute immobilization the bones may be wired or nailed together

IMMOBILIZATION The joint is immobilized by means of splints or a plaster of Paris casing until bony union is complete, which usually requires six or more weeks

As in the case of fractures it is advisable to immobilize the joints above and below the excised joint for the first three weeks, as some of the muscles which move them cross the affected joint After this period the immobilization should be confined to the excised joint

After union has occurred, the plaster casing is replaced by a well fitting leather splint and the patient is allowed to walk about

The leather splint should be worn for at least a year but in the case of children owing to the tendency to irregular growth of the limb it will be required for two or three years

DRAINAGE Owing to the liability to infection in these cases drainage is not as a rule employed except when special indications exist such as the persistent oozing of blood

When drainage has been employed the drain is removed on the third day and owing to the liability to infection all dressings must be carried out with the strictest aseptic precautions It is advantageous in these cases to have an interrupted splint or a large window cut in the plaster casing so that the wound can be dressed without displacing the bones

DRESSING If no drainage has been employed and there is no evidence of infection the wound need not be dressed until the tenth day, when the stitches are removed and the dressing changed

PAIN After excision of a joint there is always a considerable amount of pain and this should be alleviated by elevating the limb especially slinging it well up in a cradle (if the splint so permits) and by the administration of morphia

MASSAGE Regular massage is of the greatest benefit in preventing wasting and atrophy of the muscles

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Movements Passive movements should be instituted as soon as the infection has been overcome but the limb should be kept in a removable metal splint until the wound has healed in order to prevent contraction of the muscles and subsequent deformity of the joint

Reactionary Hæmorrhage Owing to the severe degree of shock produced in joint operations a watch should be kept for signs of reactionary hæmorrhage Accordingly the nurse must frequently inspect the dressings

Yielding of the Callus may occur with the result that the union of the ankylosed joint is not at the desired angle This is more likely to happen in the case of children and hence the necessity for prolonged splinting

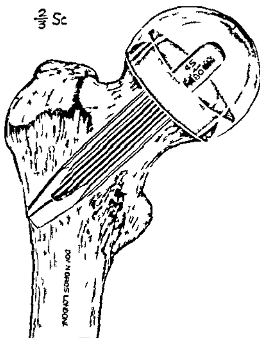


Fig 339 Judet s plain perspex hip prosthesis which is available in 12 standard sizes the head being 41 43 45 or 47 mm in diameter and the length of the stem 6 7 or 8 cm

Judet s prosthesis is also available in Vitallium and this is now con sidered to be superior to perspex The standard size of the metal head is 53 mm in diameter

Adhesions may form even though a movable joint is desired, and they lead to great limitation of movement They are especially prone to occur if early movement is not adopted or if sepsis ensues

Arthroplasty

Preparation for Operation The preparation for operation is similar to that already described for other joint operations but special attention must be paid to improving the muscles around the joint

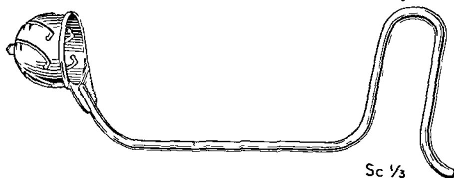


Fig 340 Judet s acetabulum reamer

Movable Joint

Where movement is desired after excision of a joint the main object to be borne in mind during after treatment is the prevention of *the formation of adhesions* *Hence active and passive movements* and massage must be systematically carried out from the earliest possible date

IMMOBILIZATION Immobilization of the joint should not be maintained longer than is necessary to accomplish repair of the wound hence as soon as the stitches are removed a removable casing should be applied so that active and passive movements can be carried out daily

EXTENSION Extension is applied to the limb in order to separate the bony surfaces and prevent their union

DRESSING *The wound need not be dressed until the tenth day* when the stitches are removed and a dressing applied

MOVEMENTS As soon as the wound has healed *i e* about the tenth day active and passive movements of the joint should be instituted the casing should be removed for several hours each day, and the patient encouraged to move the joint with a view to facilitating the return of function

If the healing of the wound is still progressing slowly the starting of movements should not be delayed beyond three weeks

At the end of about three weeks the splint should be left off during the day and the arm carried in a sling and regularly exercised

MASSAGE Massage of the muscles moving the joint is of the greatest benefit in keeping up their development and also in preventing limitation of movement caused by adhesion of their tendons

The scar should also be massaged in order to prevent its becoming adherent to the bone which is prone to occur This is a common cause of subsequent pain

Special Complications The complications after excision of joints are very much the same as after operations in general the chief being hæmorrhage, shock and sepsis

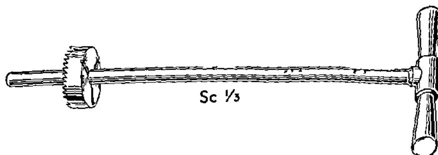


FIG 338 Judet s reamer for reshaping the neck of the femur before applying a Judet s prosthesis

Injection of Joints

In patients suffering from osteoarthritis and especially when the disease is confined to a single joint various substances have been tried for injection into the joints

At present one solution used for such intra articular injections contains 50 mg of hydrocortisone, 1 000 units of hyaluronidase and 2 per cent procaine

With injection into or aspiration from a joint strict asepsis is essential An infected joint will become a stiff joint or it will lead to a fatal septicæmia

Formerly, a pad of connective tissue was placed between the two bone ends in the hope that a bursa would develop in this pad and act as a synovial cavity

As this so often led to a stiff rather than a movable joint when it was performed on the hip, various prostheses to form false hip joint

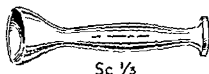


FIG 341 Judet s impactor

have been tried At first stainless steel and vitallium moulds were placed over the old head of the femur after it was reshaped but these have been replaced by the acrylic prosthesis of Judet and later by the Vitallium prostheses of Judet and of Moore In these types of arthroplasty the head of the femur is removed and the stem of the

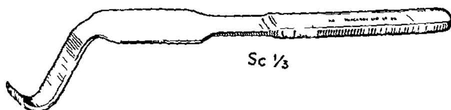


FIG 342 Judet s retractor for elevating the neck of the femur

new head is inserted down the neck of the femur (Judet s) or down the shaft of the femur (Moore s) The acetabular cavity is reshaped with special reamers to take the new head

After treatment Following an arthroplasty on joints other than the hip joint the after treatment is similar to that discussed above under Movable Joint However an arthroplasty on the hip joint is a very extensive operation and there are special points in its after treatment

The patients on whom a Judet s or similar arthroplasty is performed are often in relatively poor condition and measures to combat shock may be required Also it is probably wise to give a prophylactic course of penicillin since an infected wound spells failure of the operation and a hypostatic pneumonia is always a possibility

After Judet s operation fixation is important but this should not prevent massage of the muscles and movements of other joints Once movement is permitted after this operation exercises are started Before being discharged the patient should be taught to climb stairs

Injection of Joints

In patients suffering from osteoarthritis and especially when the disease is confined to a single joint, various substances have been tried for injection into the joints

At present one solution used for such intra-articular injections contains 50 mg of hydrocortisone, 1 000 units of hyaluronidase and 2 per cent procaine

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CHAPTER 33

THE SPINE

FRACTURES OF THE SPINE

THE spine may be fractured in any part of its length and the fracture may be due to either direct or indirect violence One or more vertebræ may be fractured and there may or may not be displacements of the fragments If there is displacement the spinal cord is liable to be compressed or torn (Fig 344) thus causing partial or complete interference with its function The gravity of the lesion depends on the extent of damage to the spinal cord and in general the lower the site of the injury down the spine the less is the immediate danger to life If the spinal cord is completely severed above the fifth cervical vertebra instant death occurs due to paralysis of the phrenic and other nerves and therefore of the respiratory muscles

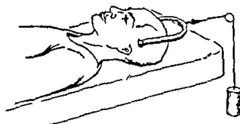


FIG 343 Skull traction forceps for use in cases of fracture dislocations of the cervical spine

Treatment of Fractured Spine TEMPORARY OR FIRST AID TREATMENT The first aid treatment of a fractured spine consists in keeping the patient flat on his back and preventing all movements until a suitable stretcher improvised or otherwise is obtained



FIG 344 Diagram showing wedging of a fractured thoracic vertebral body

The spinal cord passes behind the bodies of the vertebræ and at the time of such an injury it may be severely damaged by the prominent vertebral body

If a stretcher has to be improvised a firm flat unyielding surface such as a shutter or door is used Place the stretcher alongside the patient and while the patient keeps himself rigid roll him on to the stretcher taking care to roll him uniformly (in one piece) If this is impracticable and the patient is lying in any position other than on the face roll him on to his face and then lift him face

downwards on to the stretcher In the lifting two bearers should support the upper part of the body and two the lower and all four must take great care to act in harmony so that no twisting or wrenching of the spine occurs

No case of fractured spine should ever be moved by lifting from one place to another unless he is first turned into the prone position that is face downwards and he must be carried in this position

In most cases he will be comfortable on his face If respiratory distress should arise, one shoulder is raised by means of a folded coat If still not relieved, the patient may be rolled on to one side

INJURY TO THE SPINAL CORD In cases of severe injury, advanced tuberculosis or malignant disease of the spine the vertebral bodies may be so completely destroyed that there is insufficient bony tissue to maintain the integrity of the vertebral column In all of these cases the greatest care must be taken in moving the patient lest a vertebra is displaced and the spinal cord injured

PERMANENT TREATMENT The nursing of a fracture of the spine will be governed largely by the presence or absence of paralysis bed sores and incontinence of the bladder and rectum The main points as regards nursing such a patient are enumerated below

Bed Fracture boards should be laid on the bed (Fig 300) and a Macewen s or other divided mattress used

A draw mackintosh, covered with a drawsheet should be placed underneath the buttocks, and one small firm pillow underneath the head In the case of a fractured cervical spine the pillow under the head will be omitted and the head will be steadied by a sandbag on each side of it Ring pillows are used to protect the parts subjected to pressure and a cradle removes the weight of the bedclothes from the feet

When the under sheets are being changed the patient should be rolled *en bloc* Two nurses do this while a third attends to the patient s back and changes the sheet

Undressing the Patient The greatest care must be taken in undressing the patient and all unnecessary movement avoided He must be undressed without being turned or lifted and the seams of the clothes will be cut if necessary

Fixation of the Fragments Fractures of the cervical spine may require traction on the head to overcome the deformity and this may be obtained with a hook under each zygoma or better by Blackburn s skull traction apparatus which fits into two trephine holes in the side of the skull (Fig 343) After reduction the spine is fixed by means of a plaster jacket In most other cases of fractured spine reduction is obtained simply by hyperextension for fixation a plaster jacket is also used

An emergency hammock frame for the application of plaster jackets

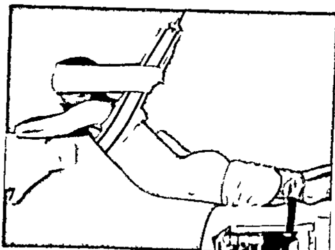




FIG 345 The position of the patient for the application of a plaster jacket for the treatment of a fracture of a lumbar or lower thoracic vertebra and the completed jacket

(By kind permission of T J Smith & Nephew Ltd)

in cases of fractures of the lower half of the spine may be improvised by removing the foot piece from a hospital bedstead and putting a second headpiece with smooth top rail in its place The patient then lies face downwards on roller towelling stretched between the two head pieces, the head arms and shoulders resting on the head of the bed stead By tightening or slackening the towelling the necessary curvature can be given to the patient s back

Two tables placed about three feet apart may be used instead of the arrangement of the bed headpieces mentioned in the last paragraph

The patient s head, neck, shoulders and arms are supported on one table which is about a foot higher than the other (Fig 345) The patient s legs and lower thighs rest on the second table For the treatment of fractures of the lower half of the spine the plaster extends from below the iliac crests to the upper end of the sternum in front and to the lower part of the neck at the back

For the treatment of fractures of the upper half of the spine the jacket may be applied with the patient lying on his back with the buttocks and legs supported on a table, with the centre of the back supported by a narrow piece of wood nailed to the table or fixed under the gall bladder rest of an operating table and with the head and shoulders supported by a nurse The plaster jacket then extends up to the chin and back of the head and may even be continued over the head as a Minerva type jacket

Before the plaster jacket is applied a tube of stockinette is applied to the body It is sewn over the shoulders and is then pulled tight and fixed in position by adhesive strapping attached to the legs Adherent felt is applied over all bony prominences

Convalescence At the end of three months the fragments should have united and a spinal support is then fitted This support is used for about another four months after which it may be gradually discarded

Results of Injury to the Spinal Cord If there is pressure on the spinal cord or interference with the blood supply to a portion of the

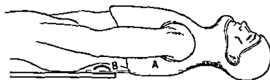


FIG 346 Diagram of a Minerva type of plaster of Paris jacket which is used for the fixation of fractures of the cervical spine

It may be applied with the patient lying partly on a table and with the upper half of the body supported by a narrow board (A) The lower end of the board is fixed to the table In the diagram it is depicted as passing under the gall bladder rest of an operating table

cord certain changes occur in the body below the site of the injury These changes create the need for special treatment The chief of these changes are —

PARALYSIS of the muscles in that part of the body lying below the site of the injury (Paraplegia) Unless prevented these muscles undergo contractures and deformities develop Preventive measures are massage passive movements and if necessary splinting

RETENTION AND INCONTINENCE OF URINE When the spinal cord is injured so that there is complete interruption of nervous impulses along it retention of urine develops If this is not relieved and the

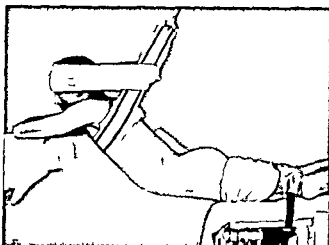




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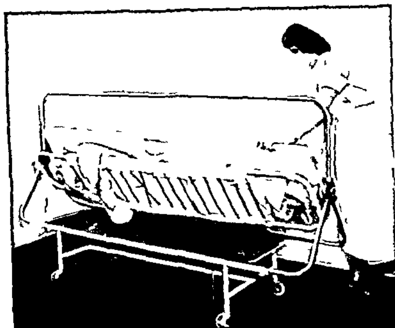


FIG 349 Having released the locking pin the patient is gently and easily turned with the two mattresses

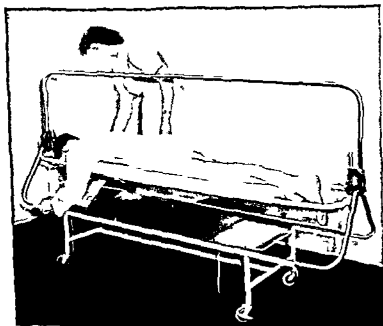


FIG 350 The patient is rotated until he is face down and the locking pin is again fixed The posterior frame is then taken off and the back is readily accessible

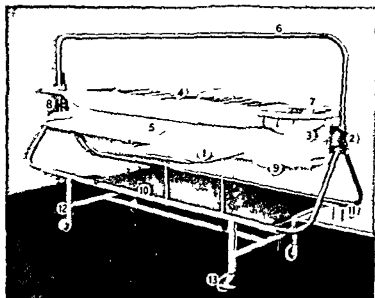


FIG 347 The Watson Victor Rotoframe

Two mattresses are firmly fixed above and below the patient for turning With this apparatus the patient may be turned frequently without any displacement of the vertebræ 1 Arm rests 2 Turning mechanism with locking device 3 Face support 4 Aperture for drainage when in prone position 5 Removable portion for use of a bedpan 6 Overhead frame for patient s use in easing his own position 7 Anterior frame 8 Provisions for traction at the head and the foot of the apparatus 9 Posterior frame 10 Platform 11 Undercarriage 12 Telescopic legs for elevation of the head or of the foot of the apparatus and 13 Easy running castors

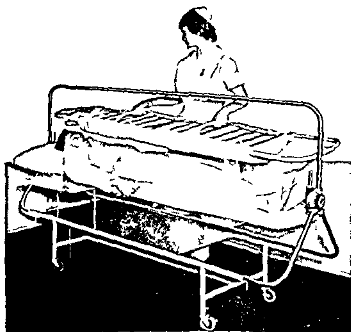


FIG 348 The patient is lying on the posterior frame of a Watson Victor Rotoframe The anterior frame is placed in position by the nurse and is firmly screwed down to make him

sterile rubber tubing to a sterile container on the floor or tied to the bed

In order to prevent or limit infection of the urine the patient is urged to take copious amounts of fluids In the initial stages sulpha-

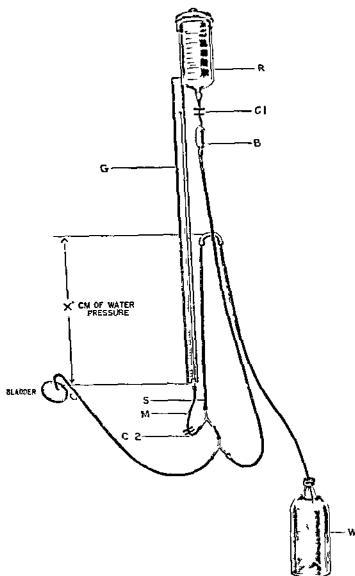


Fig 352 Double Y tidal drainage apparatus

This apparatus provides automatic intermittent irrigation and drainage of the bladder The fluid enters the bladder at a controlled rate of drip until the apparatus gradually fills to the top of the inverted U tube and thus the pressure in the bladder is then X cm of water The bladder and tubing then empty by siphonage and the process is repeated as long as fluid is supplied from the reservoir The graduated vertical tube acts as a cystometer but also provides an air vent to break the siphon each time the bladder empties The height X is determined by placing the inverted U tube at the desired distance above the bladder and thus the pressure of the fluid irrigating the bladder can be varied as required

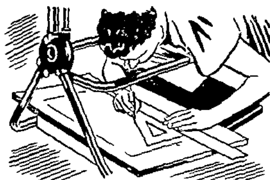


FIG 351 Many professions or trades may be learnt or continued in a Rotoframe and for these various special attachments are available

bladder becomes overfilled the urine overflows and dribbles away Later if infection of the bladder has been prevented, a stage of automatic micturition may be established that is the passage of urine may be brought about by stimulation of the skin of the inner side of the thigh, of the genitalia or of the perineum There are thus two distinct stages —

(a) Retention with overflow and (b) Automatic micturition

If the injury to the spinal cord has not resulted in complete interruption of the nervous impulses along it the stage of automatic micturition does not become established and if the stage of retention is treated without a marked cystitis occurring some control over micturition will gradually return

The treatment of the paralysed bladder in the patient with an injury to the spinal cord determines more than anything else how long the patient will live If the injury to the cord is complete and he survives more than a few days death in almost all cases will ultimately be due to an ascending urinary infection However with proper treatment this may be avoided for a considerable number of years

The retention may be relieved by intermittent catheterization or by the insertion of a tube into the bladder through the lower abdomen (suprapubic cystostomy)

Intermittent catheterization may be successful if it is carried out with strict aseptic precautions and if it is always performed by the same skilled person More often a fatal infection soon ensues, and the method of suprapubic drainage is therefore sometimes preferred

A suprapubic cystostomy allows better drainage of the bladder and if infection does inadvertently occur it is serious but less likely to be fatal The suprapubic tube either a Winsbury White s or a de Pezzer s catheter is removed every eight days and replaced with a similar sterile catheter The bladder is then washed out Under no circumstances should the wash out be given down the old tube otherwise infection will be introduced and any particles of phosphate deposited on the tube will be washed back into the bladder and will form the starting points for calculi The suprapubic tube is connected by

The initial treatment of a patient with sciatica should consist of keeping him or her in bed for some weeks If the pain persists despite that, a plaster of Paris spica may be applied, and the patient is kept in bed for a further period If there is still no relief, the prolapsed portion of the offending disc will be removed at operation This is a less extensive procedure than other types of laminectomy

Preparation for Operation The skin of the back is often thick and coarse and contains many sebaceous glands and hair follicles thus special care must be taken in its sterilization If a bed sore is present, healing should be induced before operation Failing this if the operation must be performed urgently the ulcer must be disinfected as far as possible, then covered with an impermeable sterile dressing and sealed off from the rest of the back

The operation is usually conducted with the patient in the prone position but a few surgeons prefer the patient to be on the side In either position the greatest care must always be exercised in moving the patient lest a vertebra is displaced and the spinal cord injured

In order to allow free abdominal and thoracic respiration when the prone position is used during operation all pressure must be taken off the chest and the abdomen A large firm sandbag may be placed under the pelvis a second under the upper part of the sternum, and a third smaller sandbag is adjusted under the forehead and the mouth chest and abdomen will then be free from pressure Instead of the third bag it will often be found convenient to substitute a head rest such as is used for cerebellar operations

The anæsthetic will differ according to the practice of the anæsthetist but it is generally more convenient if an intratracheal inhalational anæsthetic is adopted

In traumatic and extensive tuberculous cases accurately fitting casings for the spine should be prepared before operation These casings usually made of poroplastic felt or plaster of Paris are laid over the dressing whilst the patient is still in the prone position and are firmly secured They form a firm support for the spine and the patient can then be carefully lifted back to bed and nursed in the dorsal position

Nurses must be reminded that it can be extremely dangerous to place hot water bottles anywhere near the patient

As a prophylactic measure against infection penicillin injections may be commenced just prior to the operation and continued for a few days

After treatment The nursing of spinal operation cases will largely be governed by the general conditions existing as regards paralysis bed sores and incontinence of urine and fæces but these conditions which are the result of disease rather than of the operation have been discussed elsewhere

cetamide (½ to 1 Gm t d s) and later hexamine and an acidifying mixture are given for the same reason

If infection becomes established the frequency of the bladder irrigations is increased or the irrigations and drainage are carried out by means of a tidal drainage apparatus connected to the suprapubic tube (Fig 352)

Any patient who is kept flat on his back for a long period is very liable to develop stones in the kidneys Such an occurrence is especially seen in patients with tuberculosis of the spine and in patients with injuries to the spinal cord Also any urinary infection further increases the likelihood that renal calculi will form

If a renal calculus exists adequate doses of morphia and atropine and copious fluids may allow it to pass down the ureter If the stone blocks in a ureter ureteric catheterization or operative removal will be required

INCONTINENCE OF FÆCES Any looseness of the stools should be overcome by appropriate diet opiates kaolin etc and an action of the bowels is then obtained by an enema every morning or in many cases every second morning After evacuation the perianal skin and anus should be washed with soap and water on cotton wool and thoroughly dried in order to prevent irritation If an incontinence of liquid fæces develops this is sometimes due to the irritation of the rectal wall by a retained hard fæcal mass The removal of such impacted fæces will cure the incontinence

TROPHIC CHANGES AND LOSS OF SENSATION Because of the loss of sensation of the body below the site of the injury of the spinal cord and because of trophic changes (i e changes in the nutrition) of that part of the body the tendency to the formation of bed sores is greatly increased Treatment of these is discussed in Chapter 4

LAMINECTOMY

Laminectomy is the operation of opening the spinal canal and consists in the resection of one or more vertebral arches It is performed for fractures dislocations or inflammatory affections of the vertebræ and meninges or for the removal of spinal tumours

SLIPPED DISC Following an injury portion of an intervertebral disc may be squeezed from its position between the bodies of the vertebræ This may be symptomless or it may press on one of the emerging nerve roots of the spinal cord and cause pain Usually it is only a minor injury which produces this result and in many cases the injury is so small that it is forgotten by the patient

The commonest site for such a slipped disc is in the lower lumbar spine and it is from such a lesion that the pain usually radiates down the sciatic nerve This is the condition known as sciatica In many cases as the reparative processes proceed the sciatica passes off

The initial treatment of a patient with sciatica should consist of keeping him or her in bed for some weeks If the pain persists despite that, a plaster of Paris spica may be applied and the patient is kept in bed for a further period If there is still no relief the prolapsed portion of the offending disc will be removed at operation This is a less extensive procedure than other types of laminectomy

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must be carefully guarded against and are generally avoided by enemata and repeated catheterization

FIXATION In many cases confinement to bed for about a month usually suffices and by that time the spine is strong enough for the patient to stand up and move about

In cases of fracture or tuberculous disease however the spine remains weak for months and special supports are necessary In these cases as soon as the wound has healed the spine should be securely fixed by a plaster of Paris or similar casing After a suitable time, usually some months, this is replaced by a spinal support and the patient is allowed up

Special Complications SHOCK This is often very severe and should be treated in the usual manner Fluid should not be given per rectum as it may be returned and inadvertently soil the dressings

ESCAPE OF CEREBROSPINAL FLUID occasionally occurs where the dura has been opened Dressings may then be required from an early stage The escape of cerebrospinal fluid may be controlled by raising the foot of the bed and keeping the head low

INJURY TO THE SPINAL CORD This may occur when one (or more) vertebra is destroyed by the tuberculous process and then collapses

MENINGITIS If infection of the wound develops it may extend deeply to the meninges and spinal cord and give rise to a meningitis

POTTS DISEASE

Potts disease, or tubercular disease of the spine was first described in 1779 It consists of a tubercular infection of the bodies of the vertebræ (spinal caries) which results in their destruction and replacement by tuberculous granulation tissue Clinically it leads to the so called angular curvature of the spine or hump back

The treatment varies according to the stage of the disease In the acute stage recumbency is the most efficient method of treatment but in the convalescent stage ambulatory treatment with an efficient spinal support is usually adopted

Treatment by Recumbency If treatment by recumbency is to be adopted the following principles must be rigidly observed —

(a) All weight pressing on the diseased area must be removed this can be accomplished by recumbency

(b) All movements between the individual vertebræ must be abolished

(c) The vertebral column at the seat of disease should be arched forward in order to diminish the pressure between the bodies of the vertebræ Firm pads are placed at the seat of disease on either side of the spinous processes

THE BED If the patient lies upon an ordinary spring bed, it sags and the spine bends Thus pressure is exerted upon the contiguous vertebræ in proportion to the extent of the curve Hence, the patient

BED After operation the patient should be placed in the dorsal position on a water or rubber bed, and the head and shoulders may be fixed by fracture cloths held in position by sandbags If there is any contracture of the legs, a weight and pulley extension may have to be applied later Owing to the great risk of bed sores the most scrupulous care must be taken to avoid prolonged pressure on any area of the body and to ensure cleanliness

The dorsal recumbent position involves the daily rolling over of the patient to attend to the skin of the back shoulders and buttocks This turning is performed by means of a turning case such as a Rotoframe (Fig 347) or if this is not available, the patient keeps his body stiff and is rolled *en bloc*

DRESSING The care of the wound following laminectomy is similar to that following other operations but owing to the trophic changes the superficial wound is often slow in healing In order to lessen the pressure on the wound a thick pad of wool may be placed round it

In most cases the wound need not be dressed for ten days when it will be found to be healed but when there is much oozing the first dressing should be changed at the end of twenty four hours, and subsequently as required

Only dry dressings should be used and the greatest care must be taken to dry the skin thoroughly and re sterilize it before the dressing is re applied

Strong antiseptics and wet dressings must be avoided even when the wound is aseptic owing to the trophic disturbance of the skin

DRAINAGE Drainage is not as a rule employed, but should it have been necessary to insert a drainage tube it will be removed at the end of forty eight hours

PAIN Post operative pain is often severe but there is usually no objection to the administration of sufficient morphia to relieve it

RETENTION OF URINE is very common after spinal operations Catheterization is generally performed every six to eight hours until the patient regains control of his bladder

In these cases continuous vigilance is necessary to prevent infection of the bladder and urethra as catheterization has sometimes to be carried out for a considerable period

SKIN OF THE BACK Bed sores are extremely likely to occur and the measures already described for their prevention must be conscientiously carried out The back should be washed several times daily with soap and warm water carefully dried rubbed with methylated spirits and powdered with zinc oxide and starch powder Instead of soap and water and methylated spirits an emulsion of olive oil and a detergent may be used

The discharge of urine into the bed and soiling of the buttocks

must be carefully guarded against and are generally avoided by enemata and repeated catheterization

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must always be placed on a flat firm pillowless bed, or other apparatus so that a suitable position can be maintained for months or even years

Whilst horizontal decubitus is being maintained the nurse's main duties are to prevent the formation of bed sores and to ensure thorough cleanliness without causing any unnecessary disturbance of the spine

Couch A firm couch covered with a good horsehair mattress, and having an aperture in the centre for toilet purposes, is useful It should be firm but not too hard flat or slightly convex and pillows are



FIG 353 Gas pipe bed frame Small children may be strapped to this in order to provide rest for a lesion of the spine

inadvisable except a small ring shaped pad for the head The couch should be placed on wheels so that it can be moved out into the open air

RETENTION APPARATUS Children and also adults in the early stages of recumbency require some apparatus to prevent movements of the spine Fracture cloths should therefore be placed over the trunk and thighs and secured by sandbags on each side of the body unless a special apparatus is used In the latter case the patient will be firmly fixed by straps passing across the shoulders pelvis knees etc

Gas pipe Bed frame Bradford and Lovett's gas pipe bed frame consists of a stretcher of heavy cloth attached to a rectangular gas pipe frame The patient is attached to the frame either by straps which pass across the shoulders pelvis and knees or by means of a canvas apron which is buckled to the side of the frame The patient can be quite easily moved about in the frame which if necessary can be mounted on wheels

A Double Thomas Hip Splint with a suitable rest above to support the head

Plaster of Paris Shell For the older child and for the adult patient a plaster shell provides a satisfactory means of immobilizing the thoracic and lumbar spine while at the same time permitting the necessary care of the skin The plaster shell is made about an inch thick the posterior portion extends from the back of the thighs to the top of the head the anterior portion extends from the front of the thighs to the neck or chin and the two parts of the shell meet along the sides of the body When it is desired to turn the patient the two portions of the shell are tied together with straps After the patient is warned not to move the uppermost portion of the shell may be removed for the care of the skin of the back

EXTENSION OF THE SPINE During the acute stage extension and counter extension are very valuable

In cervical caries extension may be applied from a head sling attached to a weight and pulley extension running over the head of the bed Counter extension is furnished by the weight of the body (when the head of the bed is raised) or by means of extension applied to the limbs

When the disease affects the thoracic vertebræ extension may be applied to both legs and counter extension obtained by raising the foot of the bed

CONVALESCENCE The object of the above treatment is to produce ankylosis of the vertebræ but this takes many months Signs of consolidation however generally become manifest in about eighteen months and then the ambulatory method of treatment should be instituted At first the patient is allowed to sit up for ten to fifteen minutes daily, and this period is gradually extended until he is able to sit up for two hours, when walking may be commenced

GENERAL TREATMENT AND CHEMOTHERAPY The general treatment of tuberculosis of the spine (and of other bones and joints) has been revolutionized by the use of streptomycin isoniazid (INH) and the salts of para aminosalicylic acid (PAS) However the nursing care of these patients and the attention to general supportive measures is still of the utmost importance Fresh air and sunshine are most valuable and an abundant supply of nutritious food should be provided

Ambulatory Treatment Ambulatory treatment in Potts disease is really a method of expediency whereby the spine can be more or less fixed in as advantageous a position as possible while the patient is walking about

Various apparatuses and appliances have been employed to fix the spine and to prevent all movements thereof but even the most efficient of these fails completely to remove the superincumbent weight pressing on the diseased area

RIGID CASINGS JACKETS OR CORSETS The good effect of a jacket or casing depends partly upon the hyperextension of the spine and partly upon its thorough fixation in the improved position Unfortunately they have the disadvantage that they may be uncleanly the condition of the back cannot be watched and they are liable to irritate the skin

Plaster of Paris makes a light and fairly durable jacket and is the material usually selected for an irremovable casing When a removable casing is required however the plaster is apt to be damaged and various substitutes have been recommended such as leather celluloid papier mache and other materials For these jackets a mould is taken of the patient s trunk then a cast is made on which the jacket is fitted and allowed to dry

Plaster jackets are made by applying successive layers of plaster bandages to the patient's trunk after it has been placed in a suitable position If the disease is in the lumbar or lower thoracic spine the jacket should extend from the pelvis to above the shoulders, whereas if the disease is in the upper thoracic or cervical regions the plaster bandages should be carried up around the back of the head and forehead so as to form a head piece

To apply a plaster jacket the patient's clothes are removed, a closely fitting piece of stockinette reaching from the neck to the knees is applied and the parts liable to pressure are padded with felt The bony points are protected especially the sternum the crests of the iliac bones the sacrum and scapulæ and pressure on the spinous processes is prevented by long pads laid over the summit of the deformity on either side of the middle line Portion of the jacket over the epigastrium is removed to allow distension after meals and in the female the breasts are protected with cotton wool

As with fractures the spine is extended whilst the jacket is being applied

TAYLOR'S BRACE In the management of Pott's disease the chief movement of the spine to be avoided is the forward movement As Taylor's brace is of the nature of an antero posterior support it prevents this

In its simplest form the brace consists of two uprights of annealed steel joined together below by an inverted U shaped piece of steel which runs as far down the buttocks as possible The uprights are joined above by another U shaped piece of steel the upper ends of which pass over the shoulders to their anterior aspects Opposite the point of greatest projection carefully fitted pads are placed on either side of the spine and firmly secured to the steel uprights

The brace which is faced with hard rubber or covered with chamois leather should fit the back accurately along its whole length and press firmly on the deformity The patient is secured to the brace by means of an apron of cloth or leather which covers the front of the abdomen and chest and is fastened by straps to buckles attached to the brace

To apply the brace the patient should lie on his face with the apron spread under him the brace is then placed in position upon the bare back and the apron strapped tightly to it The brace must be worn day and night but it should be removed once daily in order that the back may be bathed rubbed with alcohol and powdered During this time the patient should lie on his face but on no account should he sit erect

Should the disease involve the cervical or upper thoracic region a ring or collar to support and carry the chin must be added to the apparatus An efficient arrangement consists of an oval steel ring which passes

round the neck and presents in front a hard rubber, accurately fitting chin piece and behind a stiff piece of leather to steady the head

STEEL SPINAL SUPPORTS The principle of these is very similar to that of Taylor s brace

The apparatus consists of a well fitting pelvic band and two vertical uprights from the upper extremity of which transverse bands pass outwards beneath the axillæ The apparatus is further reinforced by two curved bars arching over the hip bones and two lateral steel uprights which pass up to the arm pits and end in pear shaped pads The support is applied in the morning before the patient rises from the horizontal position and should not be removed at night until he or she lies down

In all cases of Pott s disease the greatest care must be taken in rolling the patient over lest the diseased ligaments are ruptured the vertebræ displaced and the cord injured In the lower part of the spine this would result in paraplegia, but above the fifth cervical vertebra it would cause instant death owing to paralysis of all the muscles of respiration

CHAPTER 34

THE EYE

Irrigation of the Conjunctival Sac This is performed to remove foreign bodies chemicals such as lime, and pus The patient lies on a couch or table with the head turned to the side of the eye to be irri gated A kidney dish is held preferably by an assistant in close apposition to the cheek but *not behind the ear* A small piece of cotton wool may be necessary between the dish and the cheek to stop fluid from running down the neck or into the ear The nurse, standing at the head of the table, gently separates the lids with one hand the other hand holds an undine containing the irrigating fluid which is usually Normal saline The temperature of the fluid is checked by pouring a little onto the hand The tip of the piece of rubber tubing attached to the end of the undine should be about two inches from the eye whilst the fluid is flowing Finally the lids are carefully dried

Instilling Drops into the Eye The lower lid is gently drawn down by the finger or thumb on the cheek bone (zygoma), and the patient is instructed to look upwards With the other hand one or two drops are placed on the upper surface of the lower lid *i e* in the lower fornix of the conjunctiva For this purpose an eye dropper is used and its tip should be about an inch from the eye

No drops or ointment should ever be inserted into an eye unless ordered by a medical officer nor should the eye be irrigated unless so ordered

Commonly used eye drops include —

Adrenaline hydrochloride 0 1 per cent
Amethocaine hydrochloride (Decicain) 0 5, 1 and 2 per cent
Argyrol, 10 per cent
Atropine sulphate 0 5 to 1 per cent
Cortisone acetate 0 5 to 1 5 per cent
Cocaine hydrochloride 2 to 4 per cent
Eserine (physostigmine) 0 25 to 1 per cent
Fluorescein 2 per cent with sodium bicarbonate 3 per cent
Homatropine hydrochloride 2 per cent with cocaine hydrochloride 2 per cent
Hydrocortisone acetate 0 5 to 2 5 per cent
Metaphen 1/2 500 (0 0004 per cent)
Penicillin 500 to 2 500 units per ml
Silver nitrate 0 5 per cent
Sodium sulphacetamide (Albucid) 30 per cent
Streptomycin 10 000 units (10 mg) per ml
Zinc sulphate 0 25 to 0 5 per cent

These drops are made up either in Normal saline or in a base which will not allow contaminating organisms to grow whilst it is in storage Such a base is Cetrimide Ophthalmic Vehicle (APF) which contains 0 005 part Cetavlon in 100 parts of distilled water When using this base to prepare eye drops the solution is boiled cooled and filtered The resulting drops are bacteriostatic fungistatic and are associated with increased corneal penetration and absorption of the drugs

A watch must be kept for evidence of any sensitivity to these substances especially to atropine

Instead of using drops various substances may be inserted into the lower fornix of the conjunctiva as lamellæ or may be injected under the conjunctiva, for example 0 4 ml of a solution containing 10 mg of cortisone acetate may be given as a subconjunctival injection

Also substances may be applied to the eye in the form of an ointment The eye ointments in common use are —

Achromycin 10 mg per gramme
Atropine alkaloid 1 per cent
Cortisone acetate ointment 1 and 1 5 per cent
Penicillin 1 000 units per gramme
Sodium sulphacetamide (Albucid) 10 per cent

BURNS OF THE EYES AND EYELIDS

The treatment of these burns differs somewhat from the treatment of other burns Three points in prophylaxis must be emphasized —

1 Burns of the eyelids are especially liable to infection and following such infection deformity of the lids may develop The lids then fail to close properly and the eye will be damaged because of exposure

2 Drying of the cornea is likely to occur unless prevented by the frequent use of oily drops penicillin ointment or of sodium sulphacetamide (Albucid) ointment It leads to corneal ulceration

3 Symblepharon may complicate conjunctival burns If the conjunctiva is badly burnt, the portion covering the globe of the eye may during healing become fixed to the part lining the lids and blindness results

This dangerous condition of symblepharon may be prevented by daily passing a smooth glass rod dipped in Vaseline right round inside the lids to break down the adhesions The surgeon may order a contact lens to keep the surfaces apart and in some severe cases an amniotic membrane graft has been used to replace the destroyed conjunctiva until it grew again

Burns of the Eyes by Acids and Alkalis

In either case the eye should be immediately irrigated with large volumes of water then with either —

(a) In acid burns a 1 per cent solution of sodium bicarbonate (baking soda a teaspoon to the pint) or

(b) in alkali burns a 1 per cent solution of boracic acid

Alkalis cause much more severe burns of the eye than acids for the body fluids are able to neutralize some of the acid fairly quickly, but they cannot counteract the alkali in a time that is at all useful

Lime burns of the eye are especially dangerous, and every speck of lime must be removed immediately even if there is no sign of inflammation in the eye The action of lime may be delayed for hours but even so, it is always extremely serious To remove the particles of lime a drop of ½ per cent solution of amethocaine hydrochloride (Decicain) is inserted as a local anæsthetic and the lids separated with an eye speculum All visible particles are removed with moist cotton wool and then the eye is irrigated with the antidote for lime viz a neutral solution of 10 per cent ammonium tartrate

Good and careful nursing is most important in the treatment of all burns but, this is especially true in cases of burns of the eye and eyelids for, in many, lack of attention will result in loss of the eye

OPHTHALMIA NEONATORUM

Ophthalmia neonatorum is an acute purulent conjunctivitis occurring in the newborn It is due to contamination of the eyes during childbirth with vaginal secretion containing gonococci, or to wiping the eyes with a contaminated rag

Newborn babies have no tears therefore, any secretion from the eyes should be reported to the doctor at once

The incubation period is one to three days but may be longer

Any discharge from the eyes up to the age of three weeks must be notified to a Department of Health in Australia and to similar bodies in many other countries

At first there is a watery secretion, then the conjunctiva becomes red Next a tense red cushion like swelling of the eyelids develops over the conjunctival sac which fills with pus The cornea becomes hazy and if treatment is delayed blindness results from corneal ulcers and subsequent scarring

Treatment PROPHYLAXIS 1 *Antenatal examination* of all pregnant women and treatment of gonorrhœa if detected

2 Immediately on birth of the head and before the eyes open each eye is cleaned with a separate dressing soaked in sterile water

3 One per cent silver nitrate or 10 per cent Argyrol is instilled in the eyes

4 When bathing a child any cloth which has touched the body must not come in contact with the face

TREATMENT OF THE ESTABLISHED DISEASE This must be carried out by a gowned and gloved attendant wearing goggles to protect her own eyes Before commencing treatment a swab is taken for examination and culture

LOCAL TREATMENT Irrigate copiously with 1 per cent solution

of sodium bicarbonate to remove the pus separating the lids with retractors if necessary This must be repeated whenever the pus reappears as it may do in five minutes

Use penicillin eye drops (2 500 units per ml) thus —

One drop every minute for half hour, then one drop every five minutes for half an hour, one drop every half hour for three hours then one drop every hour thereafter till the eyes appear dry (approximately twenty four hours), then one drop hourly for a further twenty four hours

GENERAL TREATMENT Intramuscular injections of penicillin 100 000 units every three hours for five days

Local irrigations must be used with general treatment

GONORRHŒAL CONJUNCTIVITIS IN ADULTS

The acute purulent conjunctivitis of gonorrhœal origin in adults is similar to that of infants but is even more severe It is usually conveyed by the hand following direct contact with the genitals

Treatment Prophylaxis —Every patient with gonorrhœa should be warned that he is a danger to himself and to others unless great care is taken

Treatment of the established disease is similar to that in infants The patient is confined to bed in hospital and the dosage of penicillin is proportionately increased

If the disease is unilateral the unaffected eye is sealed off by a Buller s shield which consists of a watch glass securely held in place by adhesive plaster or indiarubber sheeting The plaster or sheeting is hermetically sealed down to the nose cheek or forehead except at the lower and outer angle where a small piece of rubber tubing is inserted under the edge to allow ventilation and to prevent fogging of the glass

The patient is confined to bed and attention is paid to the general health

If the second eye shows signs of inflammation it must be similarly treated but every utensil dressing etc which is used for this eye must belong to a totally different set from those used for the bad eye otherwise it will be inoculated rather than treated In all cases it is absolutely essential that the less affected eye is dressed first

The nurse must take great care to prevent the entry of gonorrhœal pus into her eyes and therefore during treatment protective goggles should be worn When she has finished her hands must be carefully cleansed

If it so happens that pus does enter a nurse s eye the conjunctival sac should be freely irrigated with weak perchloride of mercury lotion 1 in 5 000 or with Normal saline and drops of silver nitrate 0 5 per cent or of penicillin 2 500 units per ml instilled The eye should

then be carefully watched and penicillin drops inserted at intervals for a couple of days No other treatment is indicated unless a conjunctivitis supervenes

SYPHILIS OF THE EYE

Syphilitic iritis and interstitial keratitis are discussed in Chapter 5

EYE OPERATIONS

There are two main classes of ophthalmic operations *intraocular* in which the eyeball is opened and the *extraocular* in which it is not opened With both careful nursing attention is extremely important and careless treatment will result in failure The instruments required for various eye operations are listed in Chapter 11

Intraocular Operations

Intraocular operations include —

1 Cataract extraction or the removal of an opaque lens This operation may be either an intracapsular procedure when the lens is removed in its capsule or an extracapsular procedure when the lens only is removed and its capsule remains in the eye

2 Discission or needling of a lens capsule

3 Iridectomy Excision of portion of the iris is performed —

(a) to remove the prolapsed portion of an iris after an injury

(b) during a cataract extraction and

(c) in glaucoma

4 Trephining This operation enables the fluid in the anterior chamber of the eye to pass into the subconjunctival tissues and is used in the treatment of glaucoma *i e* when there is a rise in the intraocular pressure

5 Paracentesis An incision is sometimes made in the cornea to drain pus from the anterior chamber

6 Posterior sclerotomy In some cases of glaucoma a posterior sclerotomy or incision through the sclera is made as the first stage in operative treatment

7 Removal of foreign bodies These are usually only embedded in the cornea or conjunctiva but if one has passed into the eyeball operation will be required If the foreign body is magnetic a magnet may help in its removal

8 Operation for detached retina The sclera over the affected part of the retina is heated with a special diathermy electrode in order to cause fibrosis which will bring about replacement and fixation of the retina At the same time an opening is made in the sclera to allow the escape of the fluid which has collected under the retina

Preparations for Eye Operations A swabbing is taken from the conjunctiva and cultured for forty eight hours If pathogenic organisms are present treatment with penicillin Albucid or other

drops is persisted with until these organisms are eliminated Before taking a swabbing all treatment is stopped for twenty four hours If possible distant septic foci are also eliminated before the operation

The urine should be examined and any abnormality reported If an intraocular operation is to be performed an enema should be given Any cause of coughing is treated or removed The patient should become used to sleeping propped up and to using a feeding cup urinal and bed pan All urgent business and personal matters should be attended to before operation

On the day of operation the eyelids are washed with sterile Normal saline and the eyes are irrigated with Normal saline The eyelashes may be cut short before operation but in children this is better left until after the anæsthetic is given If the scissors used for this purpose are first wiped with Vaseline the cut lashes do not fall into the eye A drop or two of penicillin 2 500 units to the ml is instilled into each eye at half hourly intervals for up to three hours before the operation Small amounts of fluids may be given up to the time of the operation if it is certain that local anæsthetic only will be used The patient should pass urine immediately before going to the theatre *The affected eye should be clearly marked*

Local anæsthesia This is used for most intraocular operations and suitable premedication is given as outlined in Chapter 13

Two drops of a 1 per cent solution of amethocaine hydrochloride (Decicain) are instilled into both eyes fifteen minutes before the operation and this is repeated in the affected eye every three minutes until the operation The eyelids are kept closed between times to prevent drying of the cornea The drops are repeated in the other eye just before the operation in order to prevent any reflex squeezing of the lids during operation when the patient will be required to keep both eyes open

Immediately prior to the operation 2 or 4 per cent procaine hydro chloride solution is injected by the surgeon in order to produce a temporary facial nerve block and paralysis of the muscles of the eyelids This is to prevent any squeezing or moving of the eyelids during the operation In the theatre during all eye operations the nurses must of course be as quiet and as gentle as possible and this especially applies when a local anæsthetic is used

Special Preparation for Certain Operations

CATARACT EXTRACTION One hour before operation on a cataract two drops of 2 per cent homatropine hydrochloride and 2 per cent cocaine hydrochloride are instilled into the eye in order to dilate the pupil

NEEDLING One per cent atropine sulphate drops are instilled into

the eye three times during the previous twenty four hours in order to dilate the pupil fully

GLAUCOMA Drops of 1 per cent eserine sulphate are usually instilled into both eyes before operations for the treatment of glaucoma

After treatment of Intraocular Operations Following operation, a piece of Vaseline gauze will usually be applied over the eyes and covered with pads and bandages The latter should not be too loose as they will then be uncomfortable and will slip and they should not be so tight as to cause pressure on the eyeball Eye pads which may be made by the nurse or purchased ready made from the drug houses consist of ovals of cotton wool with a layer of gauze on each side They are used to keep the eye closed and to protect it They are fixed in position with roller bandages or with special bandages such as Moorfield s cataract bandage which consists of a rectangular pad with tapes sufficiently long to tie in the front of the head When roller bandages are used these should be of the elastic type

Quietness and Lack of Movement

This is extremely important after intraocular operations If movement occurs before the wound is healed there is the possibility that blood vessels in the eye will tear and that some of the contents of the eyeball will be extruded Instead of pads and bandages some surgeons use a wire shield over the dressing

It is most important to explain to the patient both before and after operation that he must not touch the dressings and must not move the head

Extreme care must be taken to avoid any sudden jolting in moving the patient from the operating table back to bed

Care in the Ward after an Intraocular Operation such as a Cataract Extraction

Usually a half sitting position is adopted with the back supported on firm pillows and with the head comfortable on soft pillows All sudden efforts must be avoided for many days such as coughing blowing the nose and straining to defæcate Liquid paraffin is given regularly after operation and the patient is advised to delay opening the bowels until no effort is required Sneezing is prevented by biting the tongue

The patient is warned that there will be some pain after the local anæsthetic wears off and this should be relieved by Veganin (2 or 3 tablets) Nembudine (1 or 2 tablets) or pethidine hydrochloride (100 mg) as required In some cases the pain is intense and heavy sedation is required

A bell push is fixed near one hand both day and night The hands are loosely tied at night so that the patient cannot reach the eyes or

the bandages while asleep Help will be necessary at first with feeding and drinking Flatulence or dyspepsia may require an antacid mixture After three days the patient is turned onto the opposite side for attention to the back

DRESSINGS Before every dressing the patient must be reassured The first dressing is carried out twenty four to forty eight hours after extraction of a cataract usually by the medical officer or surgeon Strict aseptic precautions are imperative Some surgeons insert a suture at operation in the skin of the upper lid and fix it to the cheek with strapping in order to keep the eye closed till the effect of the injection of the facial nerve has worn off This suture is removed at the time of the first dressing

After the dressing is removed the opposite eyelids are cleaned with swabs soaked in warm, sterile Normal saline This is then repeated on the affected eye avoiding all pressure on the eyeball The lower lid is gently retracted with the finger and a drop of 1 per cent atropine and a drop of Argyrol sulphacetamide or penicillin instilled The dressing is repeated daily

The eye not operated upon is left uncovered after four or five days The patient is kept in bed for five to seven days and leaves hospital at the end of two weeks Straining and stooping must be avoided for many weeks All dressings are discontinued about the fourteenth day Dark glasses should be worn for a month from the time the first eye is uncovered After about a month cataract glasses are prescribed

Special Complications of Cataract Extraction 1 Post operative confusion especially in the elderly The eye not operated upon should be uncovered immediately this occurs

2 Prolapse of the iris This is due to straining and will necessitate another operation

3 Sepsis

4 Iritis

5 Hæmorrhage into the eye

Special After treatment of Other Intraocular Operations NEEDLING The pupil is kept well dilated with atropine

IRIDECTOMY FOR GLAUCOMA One per cent eserine drops are instilled daily into the eye not operated upon

TREPHINING At the time of the first dressing on the day after operation 1 per cent atropine drops are instilled into the eye operated upon and this is repeated daily One per cent eserine drops are instilled into the opposite eye daily These drops have such different actions that separate droppers are essential for their use the droppers must not be mixed On the fourth day the suture is removed from the eye operated upon

OPERATION FOR DETACHED RETINA The position of the head will be determined by the surgeon and depends on the site of the detachment After the operation the patient is kept in bed for three or four weeks and, even then as the condition is likely to recur all exertion is still avoided after getting out of bed Both eyes are kept bandaged for fourteen days The first dressing is carried out by the surgeon or medical officer on the third day and the conjunctival sutures are removed on the seventh day After fourteen days opaque goggles with a small dark central aperture are worn These limit the movements of the eyes until the retina becomes more firmly attached

Extraocular Operations

These operations include operations on the lids lacrimal apparatus, etc , for conditions such as —

CHALAZION A chalazion (Meibomian or tarsal cyst) is a granulomatous lesion of the eyelid Operation is required and if this lesion is not removed completely it will recur

PTERYGIUM This is an irregularly triangular fold of conjunctiva which grows across the cornea It is more common in Australia than in England

SQUINT The eye may be straightened at operation by either lengthening or shortening the effective length of the eye muscles and their tendons *Advancement* is the division and moving forwards of the tendinous insertion of an eye muscle into the globe whereas *recession* is the fixation of a muscle further backwards on the globe

PTOSIS Ptosis is a drooping of the upper lid and may be congenital or acquired

ECTROPION and ENTROPION These conditions are a turning out and a turning in respectively of the lower lid

LACRIMAL SAC DISEASE especially blockage of the lacrimal ducts These ducts may be probed with graduated dilators and this probing is a fairly common procedure in young infants

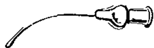


FIG 354 Lacrimal cannula

In addition to these extraocular operations the following operations are performed to remove an eye —

ENUCLEATION or excision of the eyeball At the end of this operation a glass ball may be inserted in the orbit to maintain a space for the prosthesis which will be inserted after three weeks have passed In other cases an implant of tantalum will be used to form a firm but mobile base for the prosthesis

EVISCERATION or removal of the cornea and contents of the eyeball but without removal of the sclera

EXENTERATION or removal of the eyeball and the entire contents of the orbit

Preparation for Operation The local treatment of the eye and eyelids resembles that described above for the intraocular operations The anæsthetic may be either local or general

After treatment REMOVAL OF AN EYE. The socket is kept clean by the instillation of penicillin or other drops and if necessary by irrigation with sterile Normal saline With this and other extraocular operations it is not necessary to keep the patient as still and as quiet as it is after intraocular operations

OPERATIONS ON THE LIDS Usually no dressing other than a film of Mastisol etc, is applied to these wounds Care must be taken to prevent the entry into the eye of any substance such as Mastisol which coagulates on exposure to the air

A hanging flap is often worn for a couple of days after these operations

As with other wounds of the face it is the usual practice to remove the stitches on the second to the fourth day by which time the wound should be healed

PTERYGIUM The eye operated upon is bandaged for six days, when the sutures are removed Dark glasses are then worn for a week or two Some surgeons bandage the good eye for the first three days

SQUINT Both eyes are kept covered from two to ten days depending on the type of operation The conjunctival sutures are removed on the fourth day and the muscle sutures on the fourteenth day Refractive errors must be corrected and glasses are worn once the pads are discarded Orthoptic treatment is often advisable

PTOSIS If the eye is not completely covered by the lids after the operation oily drops should be instilled and a Buller s shield worn with its edges fixed down with strapping

EXCISION OF THE LACRIMAL SAC Pressure is required on the cavity from which the lacrimal sac has been removed and this is obtained with a small roll of gauze and adhesive strapping

CORNEAL ULCERATION

A corneal ulcer is a serious condition which may lead to scarring of the cornea and to impairment of vision It may be due to infection to a foreign body or to an injury

Corneal ulcers especially if recurrent may be due to inturned lashes Corneal ulcers are also most likely to occur when the sensation of the cornea is decreased following an operation on the trigeminal ganglion or when the lids do not close properly following a lesion of the facial nerve In such cases the strapping of a watch glass over

the eye may protect it from ulceration In severe exophthalmos the corneæ may ulcerate because of exposure

A corneal ulcer may be outlined by the instillation of a few drops of 2 per cent fluorescin which will stain the ulcerated surface green These drops should be applied with a smooth glass rod

Treatment The treatment of a corneal ulcer consists of —

1 Dealing with the cause if this can be found

2 Covering and protecting the eye with an eye shield or with a pad and bandage (unless there is a profuse conjunctival discharge)

3 The application of heat by means of hot bathings or compresses to the eyelids to prevent stasis in the blood vessels

4 The use of atropine drops (1 per cent) or atropine ointment (1 per cent)

5 The frequent use of drops of penicillin or other antibiotic or of one of the sulphonamides such as sulphacetamide (Albucid)

Cortisone drops may be used whilst the inflammation is progressing but after that they should be stopped for they will delay healing if continued

In a child the arms must be splinted so that the eyes cannot be touched

For the hot bathings a wooden spoon wrapped in cotton wool and repeatedly dipped in hot water may be used This is kept as close as possible to the lids for a period of fifteen minutes at a time

If the ulcer is still spreading or is deep the patient should be confined to bed and in some cases when the ulcer is spreading it will be cauterized with pure carbolic acid by the ophthalmologist

CHAPTER 35

THE EAR, NOSE AND THROAT

By FRANK ELLIS M B M.S D L.O (Syd) F R A C.S Honorary Aural Surgeon Sydney Hospital Honorary Assistant Ear, Nose and Throat Surgeon The St George Hospital Kogarah N S W

THE OUT-PATIENT DEPARTMENT

The Out Patient Department should be prepared for the Ear Nose and Throat Surgeon and his patients as follows —

LIGHTING A suitable standard lamp with a 100-watt pearl globe is satisfactory The rest of the room s light should be subdued

LOTIONS BOWLS ETC Sterile Normal saline and sterile boracic lotion will be required for irrigation of the sinuses and ears respectively Several large receivers bowls and trays will be required

Tray of sterile instruments —

8 Nasal specula (Thudichum s sizes 1 2, 3 and infants)
6 Metal tongue depressors (Lack s small and large)
12 Aural specula (small medium and large)
4 Angled packing forceps (2 aural and 2 nasal)
Scissors
Laryngeal and post nasal mirrors (assorted sizes with 2 or 3 detachable handles)
Caloric testing apparatus
Smell and taste test bottles
2 Ear syringes (4 oz metal)
Set of aural instruments (Hartmann s)
2 Antral proof puncture trochars and cannulæ
Scalpel (No 3 handle with No 10 and No 15 blades)
Higginson s syringe

Drugs —

Cocaine hydrochloride solution 10 per cent
Decicain (amethocaine hydrochloride) solution 1 and 2 per cent
Silver nitrate solution 10 per cent
Rectified spirit
Hydrogen peroxide (8 volumes)
Adrenaline hydrochloride 1 1000 solution
Trichloracetic acid crystals
Ichthyol 10 per cent in glycerine

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If the ulcer is still spreading or is deep the patient should be confined to bed and in some cases when the ulcer is spreading it will be cauterized with pure carbolic acid by the ophthalmologist

with a sterile pad and bandage The patient should be suitably prepared for a general anæsthetic

B For simple endaural procedures such as aural polypectomy

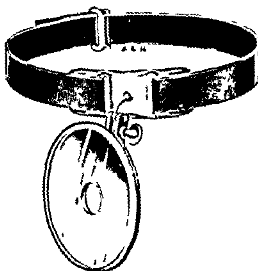


Fig 355 Head mirror

and paracentesis tympani the hair need not be shaved but the ear and meatus should be purified as above The patient should be prepared for general anæsthetic

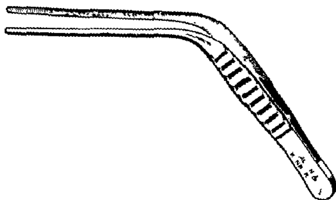


Fig 356 Aural forceps

The Operations, and a Brief Description of Each

PARACENTESIS TYMPANI (MYRINGOTOMY)

This is a simple incision of the tympanic membrane usually for acute otitis media

Special Requirements Cotton wool tipped applicators half inch ribbon gauze strips rectified spirits adrenalin and sterile swab sticks

Other equipment —

Cotton wool
Gauze squares
Ribbon gauze (½ and 1 inch)
Small glass measures
Wooden applicators
Spirit lamp
Head mirror
Tuning forks (C^0 128 c p s C^1 256 c p s C 512 c p s C^3 1024 c p s C^4 2048 c p s C^5 4096 c p s)
Barany noise box
Eustachian catheter set auscultation tubes and inflating bag
Politzer bag
Water tumbler
Powder insufflators and liquid sprays
Medicine droppers
Transilluminating apparatus (for use in dark room)
Electric cautery and cautery points
Suction apparatus and special suction tips

EAR OPERATIONS

THE methods of inserting drops into the ear and of syringing out the ear are described in Chapter 7

Ear operations can be classified as follows —

A **Transmeatal (endaural)** These are done either *via* an aural speculum or *via* incisions exposing the meatal walls and tympanic membrane They include —paracentesis tympani (myringotomy) removal of an aural polypus incision of an aural furuncle endaural mastoidectomy the fenestration operation and mobilization of the stapes

B **Post auricular** These are done *via* an incision behind the ear over the mastoid process They include —Schwartze s or cortical mastoidectomy the radical or modified radical mastoidectomy post auricular fenestration operation and tympanoplasty

The instruments required for ear operations are described in Chapter 11

Preparation of the Patient for an Ear Operation

A For mastoidectomy or fenestration The hair should be shaved for two inches around the ear and mastoid region unless specified otherwise In the case of women the hair beyond the shaved area should be smeared with Vaseline in order to keep it in place The meatus is gently syringed out with a mild antiseptic lotion The shaved area and the ear should be cleansed with soap and water ether and rectified spirits and unless specified otherwise a dry sterile wick is inserted in the meatus and the whole ear co

Instruments Required See Chapter II

Position of Patient The head should be turned well towards the opposite side to bring the affected ear uppermost The area should be swabbed over with Cetavlon then spirit Draping is important The ear and the portion immediately in front and above it should be the only parts exposed

After treatment A good sized pad of combine dressing or numerous fluffed up gauze squares should be placed over the ear and its surroundings A crepe bandage is then applied The outer dressings should be changed daily for four days when the packing will usually be partly or wholly removed If there is any pain administer aspirin or morphia as prescribed The patient will usually be having an antibiotic If there is no contra indication early ambulation is satisfactory and usual

FENESTRATION OPERATION

This is carried out for the condition known as otosclerosis in which the stapes on each side has become ankylosed sufficiently to cause considerable impairment of hearing The operation is done usually on the more affected ear The mastoid cells are cleared out and a new window (the fenestra nov ovalis) is created in the lateral semi circular canal A tympanomeatal flap which was previously prepared is placed over the new window As a result of the operation the fluids in the internal ear are mobilized again and a worth while improvement in hearing can frequently be achieved

The cavity is usually packed with porowax tulle gras or Calgitex (special E N T grade) Some surgeons use skin grafts taken from the thigh so that preparation of a thigh as a donor site may be necessary

Position of Patient As for endaural mastoidectomy

After treatment This is similar to what is done for endaural mastoidectomy Vertigo is frequently complained of and special tablets such as Avomine or Andramine often relieve this Early ambulation is advisable as soon as the vertigo permits The patient is customarily ordered an antibiotic or chemotherapy for one week

Post operative Dressing The pad should be changed within forty eight hours and the wound inspected Any gauze drains may require removal A fresh pad and bandage is applied The sutures are usually removed on the fourth post operative day

"Deep Dressing" The surgeon or his assistant usually prefers to do this on or after the seventh post operative day Requirements for this are —Head light or head mirror and reflected light sterile towels sterile gloves aural forceps and scissors aural specula Calgitex and other special dressings for repacking the cavity

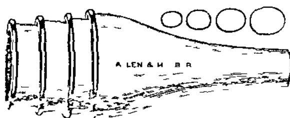


FIG 357 Aural specula These are available in four sizes

After treatment A sterile piece of cotton wool is usually inserted loosely in the outer part of the meatus This is changed as frequently as necessary

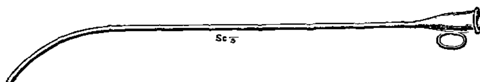


FIG 358 Kramer s Eustachian catheter

REMOVAL OF AURAL POLYPUS

This is the removal of a polypoidal growth from the tympanic membrane region with an aural snare or special aural forceps These tumours can be quite large and bleeding may be troublesome

Special Requirements Half inch gauze strips adrenalin cotton wool tipped applicators

After treatment As for paracentesis If there is any pain apply heat externally and administer aspirin or morphia as ordered

INCISION OF AURAL FURUNCLE

Special Requirements Aural specula and a fine scalpel (No 3 handle and No 11 blades) suction tip ribbon gauze and aural packing forceps

ENDAURAL MASTOIDECTOMY

This is usually done for chronic mastoiditis or cholesteatoma of the mastoid and the operation carried out is usually a radical mastoid ectomy or a modified radical mastoidectomy It is an alternate approach to the mastoid as opposed to the post auricular route The intention of the operation is to remove bone from the mastoid cavity and posterior bony meatal wall in order to convert the mastoid cavity and the middle ear cleft into one cavity A flap of skin of the meatal wall is turned into the cavity thus permitting after treatment *via* the meatus The mastoid cavity is packed with Vaselined gauze or tulle gras

Instruments Required See Chapter 11

Position of Patient The head should be turned well towards the opposite side to bring the affected ear uppermost The area should be swabbed over with Cetavlon then spirit Draping is important The ear and the portion immediately in front and above it should be the only parts exposed

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MOBILIZATION OF THE STAPES

This new operation for otosclerosis replaces to a degree the fenestration operation In this procedure the surgeon lifts the tympanic membrane out of its groove and approaches the ankylosed stapes direct He endeavours to fracture the ankylosing bone and so render the stapes mobile It is usually done under local anæsthesia using an aural speculum and head light

Preparation of the Patient The hair is not shaved unless specified In women the hair should be Vaselined to keep it away from the ear

Special Requirements Tiny cotton balls about ¼ inch diameter, adrenalin 1 1 000 sterile Normal saline ½ inch ribbon gauze strips and scissors

After-treatment No pad or bandage is as a rule applied, and after-care is minimal The patient need not be kept in bed after the premedication has worn off

THE SCHWARTZE S (CORTICAL) MASTOIDECTOMY

This is usually done for acute or sub acute mastoiditis and it involves removal of the mastoid cortex to expose and drain the mastoid antrum and cavity It is usually done *via* the post auricular approach After operation the meatus is packed with dry gauze to prevent post operative contraction The wound is usually loosely closed with skin sutures around some form of drainage

After treatment The patient will usually be having chemotherapy or antibiotics Any drainage material is removed about forty eight hours post operatively The sutures should be removed on or after the sixth post operative day The meatal packing is changed as often as is necessary until the discharge dries up Early ambulation is satisfactory provided there is no complication To relieve pain aspirin or morphia is given

THE POST AURICULAR MODIFIED (CONSERVATIVE) RADICAL OR RADICAL MASTOIDECTOMY

These operations are similar to the endaural mastoid operation except that the approach is from behind the ear They are usually done for chronic mastoiditis The mastoid antrum is opened using either gouges and mallet or the dental engine and mastoid burrs The mastoid air cells are removed and the whole cavity is laid open into the meatus by cutting a meatal flap which is turned into the cavity The opening thus made is kept open by either a drainage tube or by packing and the post auricular wound is closed loosely with skin sutures and a pad and bandage applied The aim is to obtain a clean dry cavity but this may only be achieved after several weeks of careful post operative dressings and attention

Instruments Required These are similar to those required for the endaural operation (see Chapter 11) except that the mastoid goug

and mallet are more likely to be used than the dental engine and burrs. A long roll of two inch gauze should be available for packing off the lateral sinus should this be injured.

After treatment. This is identical with that of the endaural operation except that the tube or packing from the meatus and mastoid cavity will be removed and changed on or about the fourth day.

POST AURICULAR FENESTRATION

The fenestration operation is sometimes done *via* a post auricular route.

TYMPANOPLASTY

This refers to plastic procedures carried out in the middle ear region in cases of active or past middle ear and mastoid infection. The object of the operation is to reconstruct a useful organ of hearing. The preparation, instruments and after-care are similar to those required for the post auricular mastoidectomy operation.

Special Post-operative Complications to the Major Aural Operations

Facial Paralysis. Unless it was present pre operatively this is due to operative trauma and should be notified at once. It does not become apparent until the patient recovers from deep anæsthesia. It is characterized by lack of facial movement on the affected side, the patient being unable to close the eyes, wrinkle the forehead or lift the corner of the mouth. There is a delayed form of facial paralysis which comes on at any time after recovery from the anæsthetic. This is due to œdema; recovery is likely under conservative treatment.

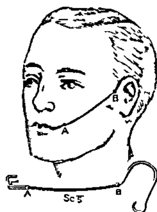


FIG 359. Splint for facial paralysis

Labyrinthitis. This causes vertigo, vomiting and nystagmus. It may be the result of mastoid or middle ear disease or operation. If it is accompanied by fever it is usually due to the spread of the infection. Otherwise it may be due to a serous effusion into the labyrinth.

Intracranial Complications. These are serious and are evidenced by lethargy, headache, vomiting or neck stiffness and retraction. The chief complications concerned are as follows —

EXTRA DURAL ABSCESS. With this, there is headache on the side of the mastoiditis and sometimes tenderness around the mastoid region. The pulse may be elevated or slowed. The temperature is moderate.

SINUS THROMBOSIS. There is pain behind the mastoid region and a high or hectic chart. Rigors may occur and septicæmia sometimes follows.

MENINGITIS There is drowsiness, headache vomiting The respiration is increased, and the pulse is usually rapid and may be irregular The temperature is usually high Neck stiffness and/or retraction is always evident

BRAIN ABSCESS This may be cerebral or cerebellar In both there is a generalized or unilateral headache, the temperature is usually low, the respiration is slowed and the pulse is slow Vomiting and nystagmus are usually present with a cerebellar abscess Aphasia or a change of personality is common with a cerebral abscess

PETROSITIS This is due to a spread of the mastoid infection along the petrous bone towards its tip Here lie the fifth and sixth cranial nerves and they are involved in the infective process Gradenigo s syndrome follows which comprises (1) Unilateral headache (2) Pain behind the eye (3) Paralysis of the abducent nerve, *i e* inability to turn the eye outward

NASAL AND SINUS OPERATIONS

The technique of giving a nasal douche is described in Chapter 7

Local Anæsthesia As many nasal operations are carried out under local anæsthesia it would be as well to enumerate the common ones used They are —

(a) Topical anæsthetics These act by their effect when applied to the mucous membrane surfaces They are (1) Cocaine hydrochloride This is used in strengths of 5 to 10 per cent and because of the risk of absorption it is usually mixed with equal parts of adrenalin 1 1 000 Solutions of cocaine are usually coloured red to distinguish them readily from other solutions (2) Decicain (amethocaine hydro chloride) 1 or 2 per cent solutions This is coloured blue It is mixed with a small quantity of adrenalin to slow its absorption

(b) Local anæsthetics for injection Novocaine (procaine hydro chloride) in ½ 1 or 2 per cent solution with or without adrenalin is commonly used

To avoid serious accidents the nurse should always show the container of the local anæsthetic to the surgeon prior to its use and tell him clearly what the solution is and what is its strength Instruments required for nasal operations are described in Chapter 11

Preparation of the Patient for Operations on the Nose or Sinuses

It is impossible to render the nasal cavities sterile but when a purulent discharge is present the nose should be well douched with a warm solution of sodium chloride or of sodium bicarbonate and boric acid together The strength of the latter solution should be one teaspoon of a mixture containing equal parts of the two substances to one pint of water The patient s face should be well cleansed with soap and water and any moustache or beard shaved Under no

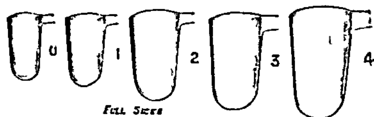


FIG 360 Thudichum s nasal speculum This is available in five sizes

circumstances must the eyebrows be shaved In practically all cases of operation on the nasal cavity or sinuses the nose will be packed twenty to thirty minutes pre operatively This applies whether local or general anæsthesia is to be used The surgeon may wish to do this himself, but if it is left to the nurse, the procedure is as follows —

One drachm of cocaine 10 per cent solution is mixed with one drachm of adrenalin 1 1 000 A strip of half inch ribbon gauze about fifteen inches long is wrung out in this solution and is then gently packed into the nasal cavity beginning towards the floor of the nose and then working up towards the roof of the nose Both sides are treated in the same manner It is as well to remember that the nasal membranes are very delicate and great care and gentleness should be employed while packing The following operations are carried out on the nose and nasal sinuses —

1 ANTRAL PROOF PUNCTURE

This is usually done under local anæsthetic but in young children a general anæsthetic is frequently required A waterproof apron should be placed about the patient s neck The surgeon will place a cotton wool tipped applicator moistened in the cocaine and adrenalin mixture under the inferior turbinate and leave it there for fifteen minutes He then passes a trochar and cannula through the thinnest part of the meatal wall into the antrum A Higginson s syringe is connected to the cannula and the antrum is washed out with sterile saline solution A bowl of Normal saline at body temperature will be required as well as a large dish into which the lotion flows after wash out If a culture is required a Record syringe and a sterile tube to collect the fluid should be provided If a previous antrostomy has been done an antral lavage cannula is used instead of the trochar and cannula

2 REDUCTION OF RECENT NASAL FRACTURE

The sooner these are attended to, the more likely the fractured bones will be reduced to a good position A general anæsthetic is usually required The surgeon will use various levers or forceps e g the Walsham nasal forceps are used on the nasal bones and Ash s forceps are used on the septum After reduction some packing of either half inch or one inch Vaselined gauze or Calgitex will often be necessary to hold the fractured bones in position A splint is some-

times used externally Fractures of the nose left unreduced over three weeks are often impossible to move, and a rhinoplasty may be necessary

3 REMOVAL OF FOREIGN BODIES FROM THE NOSE

The patients are usually young children The foreign bodies set up an irritation and cause obstruction and a unilateral purulent and often fœtid discharge Injudicious attempts to remove them often cause them to go further back, and there is a danger that they may be inhaled Therefore the surgeon should be notified of all cases of foreign body in the nose Small pledgets of cotton wool small forceps and a small nasal speculum should be available Usually topical anæsthesia suffices, but sometimes a general anæsthetic is required

4 CAUTERIZATION FOR EPISTAXIS

Bleeding from the nose may come from a plexus of vessels at the anterior end of the septum (Little s area) or from a vessel further back or higher up in the nasal cavity If from Little s area the bleeding can be temporarily stopped by pressure on the ala of the nose against the septum Later after applying topical anæsthesia the vessel can be destroyed with the electric cautery or with trichloracetic acid If from a more posterior vessel packing gauze soaked in adrenalin Argyrol or tinct benz co may be used The suction apparatus may be required

Post-Nasal Pack This is sometimes required to control an epistaxis A soft rubber catheter is passed down the nostril on the side of the bleeding With a tongue depressor in place the end of the catheter is grasped from just below the soft palate and drawn out of the mouth To this is tied a stout piece of silk or catgut about eighteen inches long to the middle of which is secured a pack of gauze The catheter is then withdrawn from the nose and the thread pulls the gauze pack into the post nasal space The thread is then secured to the ala of the nose and the other end comes from the mouth and is strapped to the cheek

5 SUBMUCOUS RESECTION OF THE NASAL SEPTUM

This operation is carried out to correct deviations and obstructions caused by the cartilaginous or bony portions of the nasal septum It is usually carried out under local topical anæsthesia Sometimes injections of procaine ½ or 1 per cent are used as well

Special Requirements A head mirror and lamp or a head light will be needed After operation the nose will be packed with gauze half inch or one inch plain or Vaselined

Post operative Care The nasal packing is kept in place for a varying time usually twenty four to forty eight hours During this time, a piece of gauze is kept over the nostrils to absorb any mucus or blood Morphia 10 8 mg (gr $\frac{1}{6}$) is given or some A P C mixture

may suffice. After the gauze is removed, some brisk bleeding sometimes occurs but this can usually be controlled by an ice pack to the nose. The patient can quickly be ambulatory if there is no complication.

6 REMOVAL OF NASAL POLYPI

These are grape-like masses of mucous membrane and contain jelly-like material. They usually arise in the middle meatus of the nose and are multiple. They cause nasal obstruction, headaches, discharge and a nasal voice. Their removal is usually carried out under local anaesthesia.

After-care Similar to that following submucous resection of the nasal septum.

7 INTRANASAL ANTROSTOMY

This operation is more frequently done in children than in adults. It is performed when frequent proof punctures and other methods have failed to clear up a purulent maxillary sinusitis. It is carried out under general anaesthesia and an opening is made under the inferior turbinate to permit aeration, drainage and lavage of the antrum.

8 RADICAL ANTROSTOMY (CALDWELL-LUC)

In this operation the antrum is approached from an incision under the upper lip. The soft tissues over the canine fossa are retracted and the antrum is opened into with a gouge or chisel. The contents of the antrum are removed, using forceps and curettes. Then an opening is made under the inferior turbinate to permit drainage and lavage from the nose. The incision in the mouth is closed with sutures. If much bleeding has taken place the antrum may require packing with gauze soaked in tinct benz co. The end of the gauze is brought out of the intranasal opening and is removed after twenty-four hours. Antibiotics will probably be ordered for the first four or five days.

Post-operative Care A careful watch must be kept for any bleeding from either the nose or mouth. Next day any gauze packing will usually be removed. Thereafter, care must be taken that the wound under the upper lip heals. Mouth washes are used and if a denture is worn it should be carefully inserted and removed. The surgeon may require the antrum washed out once or twice before the patient leaves hospital. For this the antral lavage cannula attached to a Higginson's syringe is used. It is gently inserted into the antrostomy opening under the inferior turbinate and a gentle stream of warm Normal saline is injected to wash out any clots or pus.

9 DRAINAGE OF THE FRONTAL SINUS BY AN OPEN OPERATION

If conservative measures aimed at curing acute frontal sinusitis have failed the sinus will have to be approached *via* an incision just below

the middle third of the eyebrow The incision curves down on to the nose between the inner canthus of the eye and the midline of the nose The floor of the sinus is broken into and the pus evacuated The sinus can simply be drained by means of a tube through this opening and left until it is seen by means of instilling a little coloured penicillin through the tube, that the duct into the nose is open The tube is then removed At other times, the surgeon may enlarge the fronto nasal duct region and insert a tube along it One end of the tube will be in the frontal sinus and the other end will lie in the nostril In chronic cases of frontal sinusitis which do not respond to conservative treatment, more radical operations are sometimes necessary These usually consist of removing the lining sinus mucosa and then establishing wide drainage into the nasal cavity or of obliteration of the sinus cavity by removal of its anterior wall The latter operation will result in some deformity

After-treatment When he has recovered from the anæsthetic the patient should be nursed in a semi Fowler s position Cold applications to the forehead are comforting whilst aspirin gr 5 two hourly or morphia in suitable doses will relieve the pain Any gauze packs will be removed in twenty four to forty eight hours, according to instructions If there is a tube drain in the sinus, this can be gently aspirated It must only be removed on the surgeon s orders When this is to be done an examination tray with nasal speculum scissors forceps swabs and saline should be in readiness

10 OPERATIONS ON THE ETHMOID SINUSES

These are sometimes approached *via* the middle meatus of the nose (intranasal ethmoidectomy) or *via* an external incision (external ethmoidectomy) The latter is sometimes done in conjunction with the external operation on the frontal sinus

11 OTHER OPERATIONS CONNECTED WITH THE NOSE

(a) ELEVATION OF FRACTURED MALAR BONE OR FRACTURED MAXILLA

A fractured malar bone can sometimes be reduced by means of an elevator inserted through a small incision within the hairline just anterior to the ear If this fails or if the fracture is further forward and involves the maxilla it is reduced by means of opening the antrum as in the Caldwell Luc operation After reduction a long strip of one inch gauze is wrung out in tinct benz co or Argyrol 5 per cent, and is inserted into the antrum to pack up the fragments The ends of the gauze can be brought out of a counter opening in the inferior meatus and the incision in the gum is closed The gauze is removed in about ten days time

(b) RHINOPLASTY

Certain elective operations are now frequently carried out for the

correction of old fractures of the nose and also for other deformities of the bony and cartilaginous portions of the nose A hump deformity may have to be removed or a bone or cartilage graft may require insertion The nose tip may require shortening or narrowing etc The nasal bones may have to be mobilized by saws and chisels and moved into a straight position This is a very specialized branch of Ear, Nose and Throat work, and is becoming increasingly important as more knowledge of the physiology of the nose is developed

SPECIAL POST OPERATIVE COMPLICATIONS TO OPERATIONS ON THE NOSE AND SINUSES

Hæmorrhage The first rule in all types of hæmorrhage is Put the patient at rest This means bed rest and sedation as required The patient is sat up to lessen the blood pressure in the head In cases of nasal hæmorrhage the instructions are to avoid coughing or sneezing and to breathe through the mouth and if necessary the mouth must be propped open Cold has an excellent vasoconstricting effect so the face and head should be bathed with ice water and an ice pack applied to the nose Vitamin K (menaphthone) has some delayed influence in improving blood coagulation and it is usually given intra muscularly Should these precautions prove ineffective the surgeon should be notified and preparations made as above for repacking the nose

Shock This depends mainly on the amount of blood lost at operation and is apt to be more marked in the very young and very old Hence nasal operations in these subjects should be avoided where possible

Sepsis Septic infection may be local or may spread to any of the accessory sinuses the orbit the cavernous sinus the meninges down the respiratory tract or may even start an osteomyelitis in the neighbouring bones

Adhesions These may form between the septum and the lateral nasal wall and should be broken down in the early stages with a cotton wool tipped applicator

THROAT OPERATIONS

INTERNALLY PERFORMED THROAT OPERATIONS

TONSILLECTOMY (AND TONSILLECTOMY AND ADENOIDECTOMY)

This is done under either general or local anæsthesia In Australia it is usually the former In children the operation is almost invariably accompanied by removal of the adenoids as well

Preparation If the patient is a child any loose teeth should be asked about and sought for and their presence reported to the surgeon At any age it is important that any sign of a cold cough or recent sore throat also is reported Prior to the operation any artificial teeth

the middle third of the eyebrow The incision curves down on to the nose between the inner canthus of the eye and the midline of the nose *The floor of the sinus is broken into and the pus evacuated* The sinus can simply be drained by means of a tube through this opening and left until it is seen by means of instilling a little coloured penicillin through the tube that the duct into the nose is open The tube is then removed At other times the surgeon may enlarge the fronto nasal duct region and insert a tube along it One end of the tube will be in the frontal sinus, and the other end will lie in the nostril In chronic cases of frontal sinusitis which do not respond to conservative treatment more radical operations are sometimes necessary These usually consist of removing the lining sinus mucosa and then establishing wide drainage into the nasal cavity, or of obliteration of the sinus cavity by removal of its anterior wall The latter operation will result in some deformity

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before the patient has recovered from the anæsthetic it may be difficult to recognize, hence a careful watch should be made of the pulse rate. Secondary hæmorrhage takes place from four to ten days after operation and is due to premature separation of the sloughs. Usually, it is not serious, but on occasions it can be quite profuse. In all cases of hæmorrhage the patient should be kept sitting upright in bed to lessen the blood pressure in the head and neck. Sedation should be given as required and an ice pack applied to the throat. Ice cubes can be given for the patient to suck. Vitamin K has some delayed influence in improving the blood coagulation and it is injected intramuscularly.

Whenever these general measures are not effective the bleeding point should be located. For this purpose a tongue depressor and direct or indirect illumination are required. First, any blood clot in the tonsillar fossa is removed. Then a swab held in a pair of forceps and moistened with adrenalin solution 1 : 1 000 is applied to the fossa for a period of ten to twenty minutes by the clock. Meantime the patient is reassured. If the bleeding does not cease under this treatment the patient will very likely have to be taken to the operating theatre and the bleeding point found and ligated. Any blood that is vomited following a tonsil operation should be examined to see if it is dark, which indicates that it is old blood, or bright, which indicates that the bleeding is recent.

2. **Infection.** There is always a slight infection of the raw surfaces, and occasionally this may be severe and spread to the regional lymph glands, the lungs or the ears. This infection can usually be controlled effectively with antibiotics or chemotherapy. Owing to congestion of the opening of the Eustachian tube a certain amount of earache is usually present for a few days following the operation. The ears should be inspected to exclude otitis media. The pain may be relieved by the application of heat, using either a hot pack, a hot water bag or any available form of radiant heat.

REMOVAL OF TUMOURS ABOUT THE FAUCES AND PHARYNX

These operations will resemble tonsillectomy and the patient's preparation and post operative care will be identical to that described above.

EXTERNALLY PERFORMED THROAT OPERATIONS

1. TRACHEOSTOMY (See Chapter 19)

2. LARYNGOFISSURE (Thyrotomy)

In this operation the thyroid cartilage is split vertically to expose the interior of the larynx. It is usually done to enable a diseased vocal cord to be removed, *e.g.* for cancer restricted to one cord. A preliminary tracheostomy may or may not be required. The operation

must be removed, and a mouth wash can be given The patient is prepared for general anæsthesia

The instruments required for tonsillectomy and throat operations are described in Chapter 11

Position of Patient Usually the dorsal recumbent position is used with a sandbag under the shoulders to prevent blood and secretions running into the trachea Some surgeons prefer to sit at the head of the table behind the patient whereas others will stand at one side of the patient s head In the latter case, a sandbag under the shoulders is not usually required For local anæsthesia the patient is frequently seated in a high backed chair or on a special operating table

After treatment 1 Bed for twenty four hours for children and four to five days for adults During this time the patient may be allowed up to a limited extent Until the patient has recovered from a general anæsthetic, he is placed in a semi prone position with the under arm at the back When recovered from the anæsthetic he is propped up on pillows to lessen the blood pressure to the raw areas After a local anæsthetic he may be sat up at once He must be warned against talking coughing or forcibly blowing the nose

2 *Diet* The diet varies with the patient Some find that they can resume almost normal diet very rapidly while others are unable to swallow more than liquids or very soft solids and these only in very small quantities for three or four days Ice cream is a great asset to these patients but any soft food can be given, care being taken that it is not too hot Normal diet can usually be resumed in from seven to ten days

3 *Pain* If adequate premedication has been given the patient will not require any sedative until he has recovered from the anæsthetic For the relief of pain aspirin is the great standby particularly before taking food It can be given in various ways although it is usually given in a watery suspension 10 gr for adults 2½ gr for children Morphia should be withheld in the very early stages because it may mask hæmorrhage but if the patient cannot sleep it may be given in amounts appropriate to the age and body weight Gargles should be avoided, as they may produce loosening of clots and premature separation of sloughs but if there is excess of mucus the mouth may be washed out with a weak solution of sodium bicarbonate

4 *Pulse* The pulse should be taken every half hour for the first four hours and then four hourly for twenty four hours Any marked increase in pulse rate should be regarded as suspicious of concealed hæmorrhage and a thorough inspection of the throat should be made

Special Complications 1 **Hæmorrhage** This is of two types primary and secondary Primary hæmorrhage takes place in the first twenty four hours and may be very profuse If it takes place

up on pillows The tracheostomy tube must be kept clear and free by repeated aspiration with a No 14 rubber catheter attached to the suction apparatus Oxygen delivered *via* the tracheostomy tube may be necessary at first A careful watch for hæmorrhage from the wound is to be kept for fear that blood will enter the tube A double layer of coarse damp gauze laid across the opening of the tracheostomy tube will help to humidify the inspired air The inner tube will need to be removed and cleansed frequently Morphia or atropine should not be given If a sedative is required it is best given *via* the feeding tube

Five per cent glucose water can be given *via* the nasal feeding tube in amounts of three to five ounces every two hours beginning about six hours post operatively After twenty four hours tube feeding with milk egg nog and strained fruit juice can be commenced and gradually increased over the next few days Mouth washes should be used several times daily Penicillin will usually be given for the first few post operative days The dressing is changed daily, and is kept firm Drainage tubes will be removed on the second post-operative day Sutures may be removed after the fourth or fifth day, but the sutures about the tracheal stoma will be left a few days longer Most patients are allowed out of bed on the third or fourth day They can often be taught to aspirate the stoma themselves in front of a mirror

The feeding tube should be left in place for ten days but before its removal a preliminary test of swallowing sips of sterile water alongside this tube should be made If there is no evidence of wound infection or leakage the tube can then be removed Only liquids are given for the first few days after removal of the tube and they should be taken slowly thereafter pureed vegetables and other soft foods may be added to the diet which is gradually amplified to include all kinds of solid food

Complications of Laryngectomy

1 **Sepsis** This is more common if the skin has been devitalized by pre operative deep X ray therapy to the cancer Adequate wound drainage proper pressure to the dressings and the antibiotics will lessen the risks of sepsis

2 **Hæmorrhage** This danger has already been mentioned and a close watch for bleeding must be kept

3 **Pharyngeal Fistula** Saliva will trickle out through the skin wound and this means the leaking of the suture line in the pharynx If this occurs the patient should be nursed on his side and care taken to prevent the entry of any of the discharge into the tracheal stoma Frequent aspirations of the stoma and repeated changes of dressings will be necessary until the fistula closes

Other complications less frequently seen include pulmonary

is usually performed under local anæsthetic but general anæsthesia is occasionally used If the latter, then a tracheostomy will be a necessary preliminary Following the operation, the muscles and skin are closed across the thyroid cartilage

Position of Patient As for tracheostomy *i e* recumbent dorsal position with the head well extended A small pillow should be placed under the shoulders

After-care If a tracheostomy has been done the after care will be similar to that following tracheostomy

No fluid or food will be given for twelve hours but the patient s mouth may be moistened and cleansed After twelve hours one ounce of sterile water is given every hour for about twelve hours then two ounces hourly are given After forty eight hours sterile fluids and semi soft feeding *can be cautiously begun After four days normal diet can be resumed* Antibiotics are frequently given for the first few days Any drainage tube will be removed in forty eight hours The sutures will be removed on the fourth or fifth post operative day Speaking must be forbidden for the first 48 hours, and the patient will be provided with a pad and pencil Surgical emphysema in the neck tissues may occur but unless it is spreading there is usually no cause for alarm

3 LARYNGECTOMY

This operation is performed for cancer of the larynx It involves the complete removal of the larynx The pharynx which is of necessity opened during the operation is subsequently closed with sutures A feeding tube will be passed *via* the nose into the œsophagus or stomach The open end of the trachea is sutured to the skin at the lower end of the wound and is the means by which the patient will now breathe The opening is called the tracheostome At first a tracheostomy tube will be fitted to keep the tracheostome widely opened but the subsequent objective is for the patient to do without a tube The normal voice is lost by this operation but many patients can be taught to speak with the œsophagus and pharynx, *i e* œsophageal speech This form of speech is managed by swallowing air and then bringing it up through vibrating tissues at the back of the tongue It is essential that the patient is encouraged to strive to learn this method of speech as soon as healing permits

Preparation for Operation Oral sepsis must be eradicated If there is sugar in the urine this condition should be first brought under control A preliminary tracheostomy may or may not have become necessary

Position of Patient The dorsal recumbent position a sandbag being placed under the shoulders and the head well extended

Post-operative Care The patient will be nursed recumbent until he has recovered from the anæsthetic and then he can be propped

weak antiseptic should be given prior to taking the patient to the operating theatre A sedative and a cough suppressant is usually ordered for one hour before the examination

Position of the Patient The patient lies in the dorsal recumbent position with no pillow The surgeon seats himself at the head of the table, behind the patient s head

Post-operative Care If a local anæsthetic has been used the patient should have no food or drink for 1½ hours after the examination for fear of an aspiration pneumonia Sterile fluids should be given for the first twenty four hours and thereafter a light diet is ordered Aspirin or morphia can be given for pain

BRONCHOSCOPY

The indications for bronchoscopy are very numerous, and the contra indications are almost nil

Preparation of the Patient Unless there is any emergency a cough suppressant such as morphia and atropine is given one half hour before bronchoscopy Dentures should be removed and a mouth wash given The patient should be fasting

Anæsthesia Local anæsthesia is usual although young children will require a general anæsthetic Infants under six months are best wrapped in a sheet and no anæsthetic given The local anæsthetic used is amethocaine (Decicain), 1 or 2 per cent, with adrenalin added The solution is sprayed into the mouth and throat, and when these areas are anæsthetized some of the solution can be dropped into the larynx and trachea with a laryngeal syringe The patient is now ready for bronchoscopy

Position of Patient Dorsal recumbent no pillow A special head rest is sometimes used

Post operative Care No food or drink for 1½ hours after broncho scopy

ŒSOPHAGOSCOPY

If a foreign body has lodged in the œsophagus, the patient may be suffering from pain or discomfort, and may be unable to swallow

Œsophagoscopy is performed to remove such a foreign body and that is its most frequent indication Other indications for œsophago scopy are (a) the examination of lesions of the œsophagus such as a carcinoma and (b) the dilatation of a stricture

Preparation of the Patient As for general anæsthesia

Position of Patient Dorsal recumbent A special head rest (Haslinger) is often attached to the operating table to hold the patient s head steady and to allow it to be properly postured

Post operative Care Sterile fluids are given for twenty four hours or longer, as required After that a light diet Antibiotics may be ordered For pain morphia or aspirin can be given

complications such as broncho pneumonia and excessive crusting around the tracheal stoma

PERORAL ENDOSCOPY

By this is meant the interior examination *via* the mouth and throat of the food and air passages Rigid metal tubes, which carry their own lighting are used for this purpose There are three such tubes and they are known as the laryngoscope for the larynx the broncho scope for the trachea and bronchial tree and the œsophagoscope for the œsophagus The purpose of these examinations are —

1 To inspect the mucosal surfaces for evidence of disease to remove tumours to take biopsies of tissue or to collect secretion for pathological examination

2 To determine and to relieve any obstruction of these hollow organs

3 To introduce radio opaque substances for special X ray studies

4 To remove foreign bodies

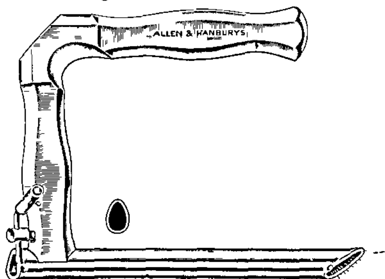


FIG 361 Chevalier Jackson s laryngoscope

LARYNGOSCOPY

This can usually be readily carried out under local topical anæsthesia but in children a general anæsthetic will be required In infants under six months it is better to use no anæsthetic the child being wrapped in a sheet and held firmly

Preparation of the Patient The patient should be kept fasting for at least four hours before the examination unless there is any emergency Dentures must be removed If there are any loose teeth these should be reported to the surgeon and the anæsthetist A mouth wash of

evening meal and the patient presents for X ray examination the following morning

No food or laxatives should be taken on the morning of the examination

If the first films show good gall bladder function a fatty meal is given and further examination made in two hours to check the function of emptying

Intravenous cholangiography is often of value in depicting the gall bladder and bile ducts

The drug (*e g* biligrafin) is excreted rapidly and films are taken at intervals a few minutes after injection By injecting pethidine hydro chloride (25 mg) the dye may be retained in the ducts for a longer time and films may be delayed for twenty minutes after the injection of the biligrafin The technique of injection is similar to that used for intravenous injections for other conditions

The patient fasts for some hours Then the skin is cleansed and the injection of 20 ml is made into a vein of the forearm The injection should be given slowly over a period of at least three minutes

Barium enema examinations call for emptying of the colon Castor oil is given on the evening preceding examination and an ordinary enema on the morning of the examination

RADIUM THERAPY

In the treatment of malignant disease radiation therapy has in the past few years played an increasingly important part

Its efficacy depends upon the greater sensitivity of the malignant cell to irradiation as compared with the normal cell The aim there fore should be to subject each cell of the neoplasm to a lethal dose of suitably screened radium

For therapeutic purposes radium is usually distributed in the form of radium sulphate enclosed either in hollow needles or metal encased glass tubes

The needles which are provided with eyelets and trocar points are constructed of platinum and are of various thicknesses according to the quantity of contained radium

They may be inserted into and around a growth (interstitial irradiation) or applied to its surface by means of wax casts (surface application)

For interstitial irradiation which is the method usually used nowadays the needles are secured in position by means of sutures or ligatures being retained for periods up to ten days at the end of which time they are withdrawn by traction on the thread running through the eyelet

After use the needles or tubes should be dipped into benzine or ether to remove dried secretions etc and then immersed in alcohol

CHAPTER 36

PREPARATION FOR RADIOLOGICAL EXAMINATION AND RADIUM THERAPY

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N S W

PREPARATION OF PATIENTS FOR X RAY EXAMINATION

FOR *fracture* examinations very little preparation is necessary Sand bags must be removed and the number of safety pins in the region of the injury should be reduced to a minimum

When metal splints are used, preparations should be made to remove them if the radiologist thinks it necessary The ordinary iron frame splints, such as the Jones splints rarely need removal as by a little care a good skiagram can be obtained by slight alteration of the angle of the X ray tube

Examination of the *renal system* (straight X rays and retrograde pyelogram) or examination of the *lower spine* calls for careful preparation Twenty four hours prior to the examination, a good dose of castor oil should be given If castor oil cannot be taken a cascara preparation may be used

When an intravenous injection is to be made in order to outline the *renal pelvis* (intravenous pyelogram) the patient is prepared as for the ordinary renal tract examination but all fluids must be withheld for twelve hours before the examination light food may be taken

Saline aperients are to be avoided as they leave the colon distended with gas Food may be taken up to the time of examination

In *gastro intestinal work* it is necessary to make the patient fast for at least six hours before the opaque meal (barium meal) is given but no previous purgation is necessary in these cases The patient must remain fasting for some hours after the opaque meal is given the radiologist will tell the patient when food may be taken Aperients must be withheld until the examination is complete Corsets must be removed and light clothing having no buttons must be worn

Chest examinations call for no special preparation Corsets must again be removed and all silk coverings also but a woollen singlet may be worn

Gall bladder examinations may be carried out after the oral administration of Priodax (tablets) or Pheniodol (powder or tablets) (Graham s test)

No previous purgation is necessary The dye is taken after the

CHAPTER 37

THE NURSING CARE OF PATIENTS UNDERGOING RADIOTHERAPY

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RADIOTHERAPY means the treatment of disease by rays from radium radon or radioactive isotopes or by X rays which may be produced at various voltages

Radiotherapy is used mainly in the treatment of cancer and it is used either alone or in combination with surgery

Some malignant tumours are very sensitive to radiation and do not therefore require very intensive treatment, but many of the common cancers need quite large doses of radiation for their control and there are inevitably, severe reactions in the particular area treated

In some cases, where wide areas of the body are irradiated general radiation effects may occur namely radiation sickness and blood changes

Let us consider the nursing care of patients undergoing various forms of radiotherapy

1 **Superficial X ray Therapy for Lesions of the Skin and Superficial Tissues** In benign conditions such as birth marks in children, the reactions are slight and generally need no special treatment In malignant cases a moist desquamation of the skin may follow and daily dressings of lanoline on lint or of Vaseline gauze are best If infection is present penicillin cream or other antibiotic ointment may be necessary The nurse should see that all irritation (such as metallic antiseptics heat or exposure to sun) is avoided

2 **Radium or Radon Treatment** There are many forms of this but only three examples will be considered

(a) IMPLANTATION OF RADIUM FOR CARCINOMA OF THE TONGUE

Carcinoma of the tongue is often treated by implantation of radium or radon needles and occasionally by radon seeds Needles are sewn into position at the operation It is important that the nurse in charge should watch that the needles do not become loose and that the correct number are present when they are removed Feeding of these cases may be difficult and requires considerable attention After removal of the needles frequent mouth washes with Normal

for ten minutes They are dried by rolling (with forceps) on sterile gauze, and then dipped in sterile paraffin to keep the metal parts in good condition Before use on another patient the same procedure should be adopted with the exception of the paraffin immersion Metal screens should be placed in the sterilizer prior to application and after use boiled and immersed in sterile paraffin before putting away

In wards devoted to radium therapy the nursing staff should be changed frequently as a prophylactic measure against the development of aplastic anæmia

Forceps four or five inches long must always be used for manipulating radium needles which should never be touched with the bare hands

It has been found economical to collect the radium emanation or radon in capillary glass tubes called seeds which are distributed throughout a neoplasm by means of a trocar and allowed to remain in the tissues indefinitely In most clinics prior to insertion the tubes are encased in tiny screens of gold or platinum

Radon rapidly deteriorates and loses half its strength in 3 8 days

The technique (Teleradium or Beam Therapy) of employing several grammes of radium (so called radium bomb) at a distance varying from three and a half to four inches from the body has been developed especially in certain Continental clinics which have at their disposal large quantities of radium

When not in use radium should be kept in small lead lined boxes provided with long handles

CHAPTER 38

COLLECTION OF PATHOLOGICAL SPECIMENS

By EVA A SHIPTON B S , M B (Syd) F R A C P

Blood For many tests it is necessary to collect blood from a vein, for others, a prick on the finger or lobe of the ear suffices to collect the quantity of blood required

Technique for the Collection of Venous Blood

A tourniquet of soft rubber tubing is drawn tightly round the patient's arm an inch or so above the elbow The fist should be kept tightly closed The skin about the superficial veins of the forearm is washed with alcohol and ether, and a sterile needle attached to a Luer syringe is inserted into a prominent vein and the required amount of blood is withdrawn

Further action depends upon the test ordered If serum is needed, the blood is placed in a sterile tube and allowed to clot if plasma or oxalated blood is needed, it is placed in a tube containing a few crystals of potassium oxalate Sometimes it is necessary to mix the blood with definite solutions to be supplied by the laboratory

Capillary Puncture

When only small quantities of blood are needed they can be obtained by this method It is also of value in fat people where the veins are invisible and impalpable The part chosen, usually the bed of the nail or the lobe of the ear, is cleaned with ether and a sharp jab is given with a straight Hagedorn needle

The resulting drop of blood is collected in a pipette If the hand is used, the flow of blood may be hastened by prior immersion in hot water or by hanging in a dependent position

The needles used must be sharp and should pierce the skin easily, otherwise the procedure is painful

Sputum Sputum refers to the secretions of the lower air passages, and is best obtained by making the patient indulge in a deep pulmonary cough after gargling the back of the throat three times with sterile water

In infants who usually swallow the sputum gastric lavage may be necessary to obtain the specimen

In children it may be exceedingly difficult to obtain sputum, as the

saline or hydrogen peroxide solution are given Antibiotics may be ordered to counteract infection Radon seeds are left in permanently and do not have to be removed

(b) Carcinoma of the Uterine Cervix

Here, radium tubes, generally in rubber containers are inserted into the uterus and vagina and left in for a certain number of days A careful check has to be kept of the number of radium tubes, of the number of containers and of the number of gauze packs which are inserted After the operation it may be necessary to pass a catheter at the end of twelve hours, but generally urine is passed naturally

After removal of the radium, vaginal douches must be given at least once daily using a mild antiseptic solution

(c) Skin Cancers

Radium is sometimes used externally on a mould for skin cancer and the care of the reaction then is similar to that used in superficial X ray therapy

3 **Deep X-ray and Supervoltage Therapy** Here the treatment may take several weeks and the nurse, by careful observation and encouragement of the patient can do much to bring about a successful result

The effects of the radiation may be (a) local or (b) general Local effects include skin reactions the care of which is mainly the avoidance of irritants and the application of a simple preparation such as lanoline or calamine cream Mucosal reactions require similar conservative care and control of infection

One general effect is *radiation sickness* characterized by loss of appetite nausea and even vomiting It varies much in severity, many patients not being affected Injections of pyridoxine 50 mg daily is often used for it and some of the anti histaminic drugs are helpful The effect on the blood when large portions of the body are irradiated has to be watched carefully The leucocytes of the blood are very sensitive to radiation and therefore frequent blood counts are necessary If anæmia follows it must be corrected

For chemical examination as for instance when the estimation of fats is required it is desirable that the complete stool is sent to the laboratory

Samples of feces obtained by the use of purgatives or of an enema are of no use for chemical examination and no liquid paraffin or other oil should be given for three or four days prior to the collection of the sample

Swabbings from Wounds, Throat, or Vagina and Cervix Uteri

PUS When an examination of pus from wounds is desired care must be taken that no antiseptic has been used for at least six hours prior to taking the swabbing otherwise the organisms causing the lesion may not grow when cultured The specimen of pus should be taken on a sterile swab stick, placed in a sterile container and sent to the laboratory immediately

THROAT SWABBINGS To obtain a satisfactory swabbing the patient should be placed in a good light and a sterile swabstick rubbed well over the affected area If a membrane is present an effort should be made to get a piece on the swab stick

SWABBINGS FROM THE VAGINA AND CERVIX Trichomonads are a common cause of vaginal discharge and a drop of the discharge has to be examined immediately under the microscope Once the discharge becomes dry or is exposed to low temperatures examination is uselsss as the trichomonads die When it is desired to grow gonococci from discharges cultures must be made from the swabbings immediately they are taken as gonococci die very quickly when exposed to room temperature

Pleural and Ascitic Fluids Two tubes should be ready when these fluids are being collected—one clean and dry the other containing some anti coagulant such as potassium oxalate sodium citrate or heparin to prevent clotting

Cerebrospinal Fluid Lumbar puncture should be performed with a special needle devised for the purpose In performing this operation absolute asepsis is essential as the most disastrous results may be occasioned by infection of the meninges The operator s hands and the patient s skin and the needle must be prepared as for a surgical operation

When it is desired to estimate the pressure accurately, a small manometer which can be attached to the needle, is required

For examination the fluid is allowed to run into a clean dry sterile tube which is at once stoppered

Several tubes should be in readiness since the first few cubic centimetres of the fluid may be contaminated with blood and therefore unsuitable for certain examinations It is absolutely essential that the test tubes are perfectly dry as the presence of any moisture alters the chloride content

tendency is to swallow it, but it is better to wait and obtain a satisfactory specimen when the opportunity arrives, than to send a specimen of saliva to be examined

The sputum should be voided into a sterile container, preferably a wide necked bottle which should be kept tightly corked except during the actual collection of the specimen

The bottle containing the specimen must be labelled plainly with the patient s name, nature of specimen, and object of examination, and sent to the pathological laboratory at the earliest opportunity

Urine To obtain urine for bacteriological examination —

IN MEN Thoroughly cleanse the glans and meatus with ethereal soap and water Collect only the last ounce of urine which will be relatively free from extraneous bacteria owing to the mechanical flushing of micturition

The specimen is collected in a wide mouthed, sterile bottle which is tightly stoppered

Only in rare instances in men is it necessary to resort to catheteriza tion to obtain a specimen for examination

IN WOMEN A satisfactory specimen can be obtained only by catheterization after preliminary cleansing with soap and water

TWENTY FOUR HOUR SAMPLE For many tests a twenty four hour sample of urine is required The patient empties the bladder at a certain hour and this specimen is discarded but from then on until the same hour on the following day all the urine passed is saved The patient must be instructed to micturate into a separate container before defæcation

An efficient method of preserving urine for analysis consists in the addition of a little toluene enough to form a continuous film over the surface of the fluid and the sample should be kept in a refrigerator For most purposes it is sufficient to send about six ounces of the urine to the laboratory after carefully measuring the total amount passed and recording same on the label together with other particulars but for some tests as in the detection of lead in lead poisoning the whole amount must be sent to the laboratory

Fæces For bacteriological examination the stool should be sent to the pathological laboratory in a small wide necked bottle tightly stoppered with a cork into which fits a stick A portion of stool about the size of a bean is collected on the flat end of this stick

If the stool is fluid half to one drachm of stool can be carefully poured into the container When the presence of dysentery either amœbic or bacillary is suspected it is essential to examine the stool as soon as possible after it is passed and if a little while must elapse before examination the specimen should be placed in an incubator or kept at blood heat by immersing the container in warm water

When sugar is found in the urine, the cause may not be clear until a dextrose tolerance test is done For this test the blood sugar is estimated in the morning with the patient fasting since the previous evening A specimen of urine is obtained at the same time The patient is then given 50 grammes of dextrose dissolved in 100 ml of water by mouth and the blood sugar taken every half hour until the end of two hours Specimens of urine are collected one and two hours after giving the dextrose

Fractional Test Meals (Fig 247) THE METHOD OF REHFUSS The patient is given a light supper consisting of 1 cup of milk containing two teaspoonfuls of charcoal or two charcoal biscuits and the examination is undertaken on the following morning before any further food or drink has been taken

Smoking is prohibited on the morning of the test

The test meal is made by boiling two tablespoonfuls of oatmeal in a quart of water until the total volume is reduced to one pint the mixture is then strained through muslin or a fine wire strainer Salt must not be used as flavouring as often the chemist wishes to analyse the chloride content of the stomach contents

The method of swallowing the tube (Fig 160) must be carefully explained to the patient who should take it in with his lips and be told to breathe freely through the nose during the act of swallowing Marks on the tube show the depth and when the tube has passed 18 inches it should have reached the stomach The whole of the fasting contents is now drawn off by means of a Record syringe and placed in a suitable clearly labelled container The meal is drunk with the tube in position and 10 ml specimens are withdrawn every quarter of an hour for two hours or until nothing further can be aspirated The tube is then withdrawn Each specimen as it is obtained must be placed in separate clearly labelled test tubes or bottles securely corked and numbered

When difficulty is experienced in the aspiration it must be remembered that this may be due to the occlusion of the tube by mucus or pieces of oatmeal (this is one reason why careful straining is necessary) also sometimes the tube works out of the stomach when it must be swallowed a few more inches The solid particles may be displaced by blowing a little air down the tube

Histamine Test Meals When it has been demonstrated that a patient fails to secure free acid in response to a gruel test meal histamine can be used as a stimulant to gastric secretion

The patient swallows the tube in the usual way the stomach is emptied and $\frac{1}{14}$th grain of histamine hydrochloride is injected sub cutaneously and specimens of gastric juice are collected every ten minutes for one hour Another method is to give the patient the gruel meal and, if at the end of two hours no free acid is secreted to give

In cases of meningitis or suspected meningitis cultures must be made immediately, as the meningococci are extremely delicate organisms and, like gonococci quickly die when exposed to room temperature

Blood Cultures If possible blood cultures should be collected when the patient has a high temperature and before antibiotics or sulpha drugs are given In cases of septicæmia or suspected septicæmia it is often necessary to make cultures from the blood to determine the organisms present To do this about 5 ml of blood is collected from a vein immediately poured from the syringe into a bottle of sterile bouillon previously obtained from the laboratory and the mixture then placed in the incubator

A blood culture to be of real value must be one of a series and the series ought to be taken at the optimum point for the collection of blood cultures that is when the temperature which has been accurately followed by means of a four hourly chart for some days is known to be on the up grade , and at a point within 1 5° of the maximum usually recorded

Under ordinary conditions it is a waste of time to undertake a blood culture unless the temperature regularly exceeds 100° Fahr

Widal Test For the Widal test for typhoid, only about 1 ml of blood is required This may be collected from a finger prick or from a vein and should be put in a clean dry tube and allowed to clot

Wassermann Tests About 5 ml of blood should be collected from a vein put in a clean dry tube and allowed to clot All tubes must be carefully labelled

Blood Counts Blood is collected from a finger prick into special pipettes for counting the red and white cells and for estimating the hæmoglobin Special fluids are needed for dilution Smears of the blood are made on clean glass slides

Blood Grouping Transfusions are now used frequently in surgical work Not only must the patient s blood be examined for the Blood Groups O A B or AB but also to see if the Rh factor is present Blood transfusion is described in Chapter 7

To carry out these examinations at least 5 ml of blood should be collected from a vein placed in a clean sterile tube stoppered and sent to the laboratory for examination

Blood Sugar and the Dextrose Tolerance Test The sugar in the blood is increased in diabetes and occasionally in other diseases when sugar is present in the urine In a normal person the blood sugar taken when fasting varies from 0 08 per cent to 0 12 per cent and after a meal rises to 0 17 per cent to 0 18 per cent but normally no sugar appears in the urine This rise after a meal makes it necessary to know the time the blood was collected and whether the patient was fasting or the time of the previous meal

If the test is performed in a ward screens should be put around the bed and the patient kept as quiet as possible Talking or reading is not permissible The normal limits of the B M R are from minus 10 per cent to plus 10 per cent

Tissue for Histological Examination The tissue must not be allowed to dry but should be placed as soon as possible after removal from the body in 5 or 10 per cent formalin in saline or if this is not available in 50 per cent methylated spirit in water The specimen should not be washed with water before being placed in the formalin or spirit It is essential to see that large specimens are covered by the solution All specimens should reach the pathologist as soon as possible

the histamine and collect the specimens for a further hour This saves the patient from swallowing the tube twice

Occasionally a patient may have a severe reaction after histamine, thus an ampoule of adrenalin and a sterile hypodermic syringe should be kept ready for use when histamine is being used

Renal Efficiency Tests There are many renal efficiency tests of varying degrees of usefulness

Those most commonly used are the estimation of the blood urea and creatinine and the urea concentration test of Maclean For the blood urea and creatinine tests 4 ml of blood are collected from a vein, well mixed with a few crystals of potassium oxalate and sent to the laboratory

For the urea concentration test the patient empties the bladder completely say at 7 a m, and is then given 15 grammes of urea dissolved in 100 ml of water to drink The bladder is emptied one, two and three hours afterwards The specimens are put in separate containers well labelled and sent to the laboratory as soon as possible The *whole* of each specimen passed must be saved The patient should have as little fluid as possible in the twenty four hours previous to the test and none during the test

The normal values are —

Time	Urea Percentage	Specific Gravity	Quantity in ml	Acidity	Albumin
Before	1 5 upwards	1010 upwards	—	+	—
1 hour	1 5 upwards	1006 upwards	less than 150	±	—
2 hours	2 5 upwards	1010 upwards	less than 100	±	—
3 hours	3 0 upwards	1015 upwards	less than 80	±	—

Estimation of the Basal Metabolic Rate (B M R) The preparation of the patient is a most important part of this test and almost always lies with the nursing staff

The apparatus should be explained and shown to the patient on the previous day so that he becomes used to breathing through the valves

The determination of the B M R is made ideally as soon as the patient has awakened in the morning and before any exertion at all Very often however this is impossible and if a journey has to be made the patient must rest for an hour after reaching the place where the estimation is performed No food must be taken for fifteen hours previous to the test and even a cup of tea or coffee in the morning spoils the test altogether Lastly the patient must be mentally free from worry or nervousness and this is sometimes difficult to attain

2 A patient is to receive a blood transfusion of two bottles of blood What are the preparations which would be made and what are the duties of the nurse during the transfusion?

3 Describe the nursing treatment of a patient who has sustained a fracture of the thoracic spine and has paralysis of the lower part of the trunk and lower limbs

4 A patient who has undergone an abdominal operation ten days earlier complains of sudden pain in the left side of the chest Discuss the nursing management of such a case and mention the possible causes of the pain

5 Define the following terms —

(*a*) Furuncle
(*b*) Contusion
(*c*) Vitamin K
(*d*) Gastrostomy
(*e*) Teno synovitis
(*f*) Actinomycosis
(*g*) Compound fracture
(*h*) Strangulated hernia
(*i*) Internal hæmorrhage
(*j*) Reactionary hæmorrhage

SPECIMEN EXAMINATION PAPERS

REGISTRATION EXAMINATION—GENERAL NURSES

NURSES REGISTRATION BOARD NEW SOUTH WALES

SURGICAL NURSING

The questions are of equal value Three hours allowed

1 Discuss the advantages of getting patients out of bed soon after an abdominal operation

2 An unconscious patient has been admitted to your ward From what may he be suffering? How can you differentiate between the various conditions? What will you do pending the arrival of a doctor and what will you specially note for his information?

3 Describe the nursing treatment of a patient after the operation of supra pubic prostatectomy Mention the complications which might occur

4 What are the signs and symptoms of peritonitis? Describe how you would nurse a patient suffering from this condition and state what are the indications (*a*) that the patient will die (*b*) that the patient will probably recover

5 Describe the nursing treatment of a patient before and after the operation of tonsillectomy

SURGICAL NURSING

The questions are of equal value Three hours allowed

1 What is the name applied to the operation for the removal of a stone from the common bile duct? Describe the nursing of a patient after this operation

2 Give a classification of burns Describe fully the nursing of a patient whose buttocks have been severely burned

3 A man is admitted to your ward and has a severe incised wound of the right calf from which he is bleeding He is pale and collapsed What is the nurse s immediate duty? Describe the surface markings of the line of the common femoral artery

4 Give the pre operative and post operative nursing of a case of suppuration of the mastoid

5 Describe the nursing procedure in lavage of the bladder in (*a*) male and (*b*) female patients

SURGICAL NURSING

The questions are of equal value Three hours allowed

1 What are the duties of the nurse in charge of a patient who is to be given a general anæsthetic? What are her duties during the stage of recovery from the anæsthetic?

Metric System

1 Litre (lit) is the volume occupied by 1 kilogram of water at the temperature of its maximum density (4 Cent)

1 Millilitre or Mil (ml) is the 1 000th part of 1 litre

Relation of Imperial and Metric Measures

1 Pint	=	568 24 ml
1 Fluid Ounce	=	28 41 ml
1 Fluid Drachm	=	3 55 ml
1 Minim (♏)	=	0 0592 ml (c c)
1 Litre	=	35 19 fluid ounces
1 Mil (ml or cc)	=	16 9 minims

For the conversion of doses from one system to another the following rough approximations are used when accuracy is not essential

Grains or Minims	to	Grammes or Mils	Divide by 15
Grains	to	Milligrams	Multiply by 60

Relation of Capacity to Mass (Imperial)

1 minim = the volume of	0 91	Grains of Water at 16 7° C
1 fluid drachm ,,	54 68	
110 minims (approx) ,,	100 0	
1 fluid ounce ,,	437 5	
16 fluid ounces ,,	7,000 0	
1 pint ,,	8,750 0	
1 gallon ,,	70,000 0	

DOMESTIC MEASURES

60 drops	= 1 medicinal teaspoonful	= 1 fl drachm
2 teaspoonfuls	= 1 ,, dessertspoonful	= 2 fl drachms
2 dessertspoonfuls	= 1 tablespoonful	= ½ fl ounce
4 tablespoonfuls	= 1 wineglassful	= 2 fl ounces
2 wineglassfuls	= 1 teacupful	= 4 fl ounces
2 teacupfuls	= 1 ,, tumblerful	= 8 fl ounces

As household spoons etc vary considerably graduated measures should be used for all medicines

The British (Imperial) measures of minim drachm and ounce are slightly smaller than the corresponding U S Apothecaries measure Also the British (Imperial) pint contains 20 ounces and the U S Apothecaries pint only contains 16 ounces

APPENDIX

WEIGHTS AND MEASURES

Used in Medicine with their abbreviations and equivalents

MEASURES OF MASS (WEIGHTS)

Imperial System

1 Pound (Avoirdupois) (lb) is the Standard Pound
1 Ounce (Avoirdupois) (oz) = the 16th part of 1 pound
= 437½ grains
1 Grain (gr) = the 7 000th part of 1 pound

Apothecaries System

1 Ounce (Apothecaries) (℥) = 480 grains (identical with the Troy ounce)
1 Grain (gr) (identical with the Imperial grain)

Metric System

1 Kilogram (Kg) is the International Kilogram
1 Gramme (Gm) is the 1 000th part of 1 Kilogram
1 Milligram (mgm) is the 1 000th part of a Gramme

Relation of Imperial Apothecaries and Metric Weights

1 Pound	=	453 59 Grammes
1 Ounce (Apoth)	=	31 10 Grammes
1 Ounce (Avoir)	=	28 35 Grammes
1 Grain	=	64 8 Milligrams
1 Kilogram	=	35 27 oz (Avoir)
1 Gramme	=	15 43 Grains
1 Milligram	=	0 0154 Grain

MEASURES OF CAPACITY (VOLUMES)

Imperial System

1 Pint (Pt) (or O) = the Imperial Standard Pint
1 Fluid Ounce (fl oz) (or ℥) = the 20th part of 1 pint = 8 fl dr
1 Fluid Drachm (fl dr) (or ʒ) = the 8th part of 1 fluid ounce
= 60 minims
1 Minim (min) (or ♏) = the 60th part of 1 fluid drachm

Metric System

1 Litre (lit) is the volume occupied by 1 kilogram of water at the temperature of its maximum density (4° Cent)

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1 fluid ounce ,	437 5	
16 fluid ounces	7,000 0	
1 pint ,	8,750 0	
1 gallon	70 000 0	

DOMESTIC MEASURES

60 drops	=	1 medicinal teaspoonful	=	1 fl drachm
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LOTIONS

GENERAL ANTISEPTIC LOTIONS

Drugs	Commercial Form	Quantity required for one pint of solution	Strength	Per cent
Boric Acid	Powder or Crystals	265 grains	1 in 33	3%
Phenol (Poison)	Liquid or Crystals	One ounce	1 in 20	5%
Perchloride of Mercury (Poison)	Powder or Crystals	Eight and three quarter grains	1 in 1 000	0 1%
Biniodide of Mercury (Poison)	Powder	Seventeen and one half grains	1 in 500	0 2%
Peroxide of Hydrogen (100 volumes)	Liquid	Two fluid ounces	1 in 10	10 vols of oxygen
Liquor Cresolis Saponatus (Poison)	Liquid	Three drachms and twelve minims	1 in 50	2%
Potassium Permanganate (Poison)	Crystals	Eight and three quarter grains	1 in 1 000	0 1%
Proflavine and Monacrin	Powder	Eight and three quarter grains	1 in 1 000	0 1%
Zephiran	10% Solution	One drachm and thirty six minims	1 in 100	0 1%
Cetavlon	Powder	Eighty seven and a half grains	1 in 100	1%
Hypochlorous Acid	Powder	Fourteen grammes of Eupad	1 in 40	0 25%

These antiseptic solutions are of the strengths ordinarily stored in stock bottles and for local application are used in these strengths or are diluted with an equal volume of hot or cold (preferably distilled) water

PERCENTAGE SOLUTIONS

If of a solid in a liquid

For 1 per cent — Take of the solid 17½ grains and dissolve in sufficient liquid to make ℥iv (or 87½ grains of solid and liquid to make Oi)

If of a liquid in a liquid

For 1 per cent — Take of the required liquid 19 minims and make up to ℥iv with the diluting liquid (or 96 minims to Oi)

FORMULAE FOR OBTAINING PERCENTAGE AND FRACTIONAL DILUTIONS

PERCENTAGE FORMULA

This formula shows the amount of diluting fluid which it is necessary to add to 1 volume of fluid of percentage x in order to reduce that volume to the desired percentage y

The formula is $\frac{x}{y} - 1$, where x represents the original percentage and y the desired percentage Thus to dilute a solution from 20 per cent to 5 per cent add to each volume of solution $\frac{20}{5} - 1 = 3$ of the diluting fluid

or from first principles, if you require to make a 5 per cent solution from a 20 per cent —

Of the solution used — 20 will be in 100
5 will be in 25

Of the solution required — 5 will be in 25 therefore take the quantity of Strong Solution that contains 5, *i e* 25, and dilute up to 100

PERCENTAGE DILUTION FORMULA

To prepare a specified volume z of a y per cent solution from an x per cent solution, take of the latter $\frac{z \times y}{x}$ volume and make up to z volume with diluting fluid

Example To obtain 12 minims of a 24 per cent solution from an 80 per cent solution take of the latter $\frac{12 \times 24}{80} = 3\ 6$ minims, and make up to 12 minims with diluting fluid

or, from first principles if *you require* 12 minims of a 24 per cent solution from an 80 per cent solution reason thus —

Of the solution required 100 contain 24

$$12 \text{ contain } \frac{24 \times 12}{100} = 2\ 88$$

Of the solution used 80 are contained in 100
2 88 are contained in

$$\frac{100 \times 2\ 88}{80} = 3\ 6$$

Therefore take 3 6 minims and dilute up to 12

FRACTIONAL DILUTION FORMULA

To prepare a specified volume z of a $\frac{1}{y}$ dilution from a $\frac{1}{x}$ dilution take of the latter $\frac{z \times x}{y}$ volume and make up to z volume with diluting fluid

Example To obtain 60 minims of a $\frac{1}{100}$ solution from a $\frac{1}{10}$ dilution take of the latter $\frac{60 \times 10}{100} = 6$ *minims* and make up to 60 *minims* with diluting fluid

PERCENTAGE SOLUTIONS

Parts	Per Cent	Grains per Fluid				
		1 Drachm	1 Ounce	8 Ounces	16 Ounces	20 Ounces
1 in 1 000	1/10	0.07	0.55	4.4	8.7	10.9
1 in 900	1/9	0.08	0.61	4.9	9.7	12.2
1 in 800	1/8	0.09	0.68	5.5	10.9	13.7
1 in 700	1/7	0.10	0.78	6.2	12.5	15.6
1 in 600	1/6	0.11	0.92	7.3	14.7	18.4
1 in 500	1/5	0.14	1.09	8.7	17.5	21.8
1 in 400	1/4	0.17	1.37	10.9	21.9	27.4
1 in 300	1/3	0.23	1.82	14.6	29.2	36.5
1 in 200	1/2	0.34	2.73	21.9	43.7	54.6
1 in 100	1	0.68	5.47	43.7	87.5	109.4
1 in 50	2	1.37	10.9	87.5	175	218.7
1 in 40	2½	1.71	13.7	109.4	218.7	273.4
1 in 33⅓	3	2.05	16.4	131.2	262.5	328.1
1 in 30	3⅓	2.28	18.2	145.8	291.7	364.6
1 in 25	4	2.73	21.9	175	350	437.5
1 in 20	5	3.42	27.3	218.7	437.5	546.8
1 in 10	10	6.84	54.7	437.5	875	1 093.8
1 in 5	20	13.67	109.4	875	1 750	2 187.5
1 in 4	25	17.09	136.7	1 093.7	2 187.5	2 734.2
1 in 3	33⅓	22.79	182.3	1 458.3	2 916.7	3 645.9
1 in 2	50	34.18	273.4	2 187.5	4 375	5 468.7

LIST OF PHRASES AND ABBREVIATIONS USED IN THE WRITING OF PRESCRIPTIONS

Latin	Abbreviation	English
ad	—	up to
ad libitum	ad lib	as much as desired
alterna nocte	alt noct	alternate nights
ana	aa	of each
ante cibos	a c	before meals
aqua	aq	water
aqua bulliens	aq bull	boiling water
aqua destillata	aq dest	distilled water
bis in die	b i d or bd	twice a day
cataplasma	cat	a poultice
collunarium	collun	a nasal douche
collyrium	collyr	an eye lotion
compositus	co	compound
confectio	conf	a confection
congius	C	*gallon*
cum	c	with
diebus alternis	die alt	alternate days
dilutus	dil	dilute
emplastrum	emp	a plaster
ex aqua	ex aq	in water
extractum liquidum	ext liq	a liquid extract
fiat mistura	ft mist	make a mixture
gargarisma	garg	a gargle
glycerinum	glyc	glycerine
granum	gr	a grain
gutta	gutt	a drop
haustus	haust	a draught
hora somni sumendum	h s s	to be taken at bedtime
in dies	in d	daily
lamellæ	lamel	small discs
liquor	liq	a solution
lotio	lot	lotion
mane nocteque	m n	morning and night
mise	M	mix
mitte	mit	send
modo dictus utendum	m d u	to be used as directed
more dictu	m d	in the manner directed
nebula	neb	a fine spray
nocte	noct	at night
octarius	O	a pint
oculentum	ocul	an eye ointment
omni nocte	o n	every night

Latin	Abbreviation	English
Pharmacopœia Britannica	B P	British Pharmacopœia
pigmentum	pig	a paint
post cibos	p c	after meals
pro re nata	p r n	as required
pro tussi	—	for a cough
pulvis	pulv	powder
quantum sufficit	q s	a sufficient quantity
quatuor in die	q i d	four times a day
recipe	℞	take
rectificatus	rect	rectified
repetatur	rep	let it be repeated
semi or semis	s s or *fs*	half
signetur	sig or S	let it be labelled
si opus sit	s o s	if necessary
spiritus vini rectificatus	s v r	rectified spirits of wine, alcohol 90%
statim	stat	immediately
stet	—	let it stand
sumendum	sum	to be taken
ter die sumendum	t d s	to be taken three times a day
ter in die	t i d	thrice daily
trochiscus	troch	a lozenge
tussi urgente	tuss urgent	when the cough is troublesome
unguentum	ung	an ointment
ut opus sit	u o s	as required
vel	v	or

NASAL LOTIONS

(1)	Sodium Bicarbonate	gr iii
	Borax	gr iii
	Liquefied Phenol	♏ ¼
	Glycerine	♏ x
	Distilled Water	to ℥i
(2)	Borax	gr iii
	Sodium Bicarbonate	gr iii
	Sodium Chloride	gr iii
	Distilled Water	to ℥i

EAR DROPS

Boric Acid	gr xvi
Alcohol (90 per cent)	ʒi/s
Water	to ℥i

DUSTING POWDERS

(1) Boric Acid, Zinc Oxide, Starch, Bismuth Carbonate — Equal parts of each

(2) Zinc Oxide, Starch, Boric Acid — Equal parts of each

(3)

Boric Acid	ʒi
Starch Powder	℥i

MOUTH WASHES

(1) Phenol (1 in 80) with a little Glycerine in warm water

(2) Peroxide of Hydrogen (2 5 vols) *i e* 1 part of Hydrogen Peroxide (10 vols) with 3 parts of water

(3) Equal parts of Lemon Juice and Soda Water

(4)

Liquefied Phenol	℥ii
Citric Acid	℥ii
Glycerine	℥ii
Peppermint Water	*to ℥xii*

ʒii to tumblerful of warm water

(5)

Oil of Cinnamon	♏xv
Oil of Peppermint	♏xv
Soluble Saccharin	ʒi
Benzoic Acid	ʒi/s
Tincture of Krameria	ʒx
Alcohol (90 per cent)	to ℥viii

ʒi to tumblerful of warm water

(6)

Potassium Chlorate	gr xxv
Glycerine	♏lx
Water	ad ℥i

HAND EMOLLIENTS

(1) Powdered Tragacanth	ʒii
Alcohol (90 per cent)	℥i
Glycerine	℥ii
Almond Oil	℥ss
Simple Tincture of Benzoin	℥ii
Oil of Lavender	♏x
Water	to ℥x

(2) Zinc Oxide	℥iii
Wool Fat	℥i
Almond Oil	℥iv
Solution of Calcium Hydroxide	℥iii

WHITEHEAD'S VARNISH

(PIGMENTUM IODOFORMI)

Iodoform	ʒi
Benzoin	ʒiv
Colophony	ʒiii
Balsam of Tolu	ʒi
Ether	℥v

BLADDER LOTIONS

(1) Boric Acid 2 per cent (8.75 gr to ℥i)
(2) Normal Saline
(3) Oxycyanide of Mercury (1 in 10,000 to 1 in 2,000)
(4) Silver Nitrate (1 in 15,000 to 1 in 5,000)
(5) Mercurochrome 1 per cent (17.5 gr to ℥iv)
(6) Potassium Permanganate (1 in 8,000)
(7) Monacrin (1 in 1,000)

BLADDER ANALGESIC

Ethyl amino benzoate Crystals	4 Gm
Menthol Crystals	0.125 Gm
Olive Oil	100 ml

The instillation of 10 to 30 ml into the bladder will give approximately twelve hours analgesia

VAGINAL DOUCHES

(1) Potassium Permanganate (0.1 per cent. to 0.3 per cent.)
(2) Dettol (0.5 per cent.)
(3) Weak Solution of Iodine (Liquor Iodi Mitis) (ʒss. to ʒi to Oi)
(4) Thymol (1 in 1,000)
(5) Normal Saline

ENEMATA

These should be given at a temperature of 100° Fahr.

EVACUANT ENEMATA

Soap and Water

Soft Soap (B.P.)	ʒi ii
Warm Water	Oi

Turpentine (Flatus Enema)

Oil of Turpentine	ʒi iv
Soap and Water Enema	Oi

Olive Oil Enema

Olive Oil	℥vi

Glycerine Enema

Glycerine	
Water	aa ℥i

ASTRINGENT ENEMA (Starch and Opium)

Tincture of Opium (Laudanum)	ʒss to ʒi
Thin Starch Mucilage	℥v

EYE DROPS

Eye drops and ointments are described in Chapter 34.

BISMUTH AND IODOFORM PASTE (BIPP)

Bismuth Subnitrate	℥iv
Iodoform	℥viii
Liquid Paraffin	℥iv

T B PAINT (GABRIEL)

Tincture of Iodine	3 parts
Compound Tincture of Benzoin	3
Camphor	1
Chloral Hydrate	1
Phenol	1

MAGNESIUM SULPHATE PHENOL PASTE

Liquefied Phenol	℥ss
Glycerine	℥i
Dehydrate Magnesium Sulphate	℥iv

Mix in hot mortar, with a hot pestle Keep the resulting paste in a tightly covered jar to prevent the absorption of moisture

The paste is spread thickly over the whole of the affected area A thick pad of absorbent cotton wool is then placed over all, and is left unchanged for twelve to twenty four hours

NEUTRAL PROFLAVINE OINTMENT
(GLEDHILL AND ALBERT)

Proflavine Sulphate B P	0 1 Gm
Starch	1 5 Gm
Sodium Bicarbonate	0 025 Gm
Water	50 ml vel q s
Tragacanth	1 5 Gm
Glycerine	50 ml
Water	ad 100 ml

TO REMOVE THE PISTON FROM A SYRINGE

1 Place the syringe in very cold water The metal piston will contract and it may then be possible to move it

2 By means of a B D Syringe Opener soapy water may be injected under pressure into the lower part of the offending syringe The B D Syringe Opener is all metal and resembles a dental syringe It is filled with soapy water and then with the nozzles of the two syringes fitted together the soapy water is forced into the other syringe with sufficient pressure to move the stuck piston

(In many cases sticking of the piston in a syringe is due to failure to wash out any blood immediately after the syringe is used)

VAGINAL DOUCHES

(1) Potassium Permanganate (0 1 per cent to 0 3 per cent)
(2) Dettol (0 5 per cent)
(3) Weak Solution of Iodine (Liquor Iodi Mitis) (ʒss to ʒi to Oi)
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BISMUTH AND IODOFORM PASTE (BIPP)

Bismuth Subnitrate	℥iv
Iodoform	℥viii
Liquid Paraffin	℥iv

Alkaline phosphatase (serum) – 3 to 10 King Armstrong units per 100 ml
Sodium (plasma) = 328 to 348 mg per 100 ml
Chloride (plasma) = 360 to 380 mg per 100 ml
Potassium (serum) = 16 4 to 20 4 mg per 100 ml

URINE

Hydrogen ion concentration = *pH* 5 0 to 7 5
Specific gravity = 1,016 to 1,020
Volume daily output = about 1,500 ml
Urea daily output = 25 to 35 Gm
Total nitrogen daily output = 10 to 17 Gm
Sodium chloride daily output = 15 Gm
Diastase = 8 000 to 30 000 units in 24 hours
17 Ketosteroids = Men 15 mg in 24 hours Women 10 mg in 24 hours

CEREBROSPINAL FLUID

Specific gravity = 1,004 to 1,006
Pressure (recumbent) = 110 to 140 m m of water
Lymphocytes = 0 to 5 per c mm
Total protein = 15 to 25 mg per cent
Sugar = 50 to 80 mg per cent
Chlorides (as NaCl) = 730 to 750 mg per cent

UNNA'S ZINC GELATIN (UNNA'S PASTE)

Zinc Oxide	ʒiiss
Gelatin	ʒvii
Glycerine	℥ii
Water	℥ii
Phenol	1 5 per cent of Total Volume

SKIN INK

Pyrogallic Acid	1 Gm
Strong solution of Ferric Chloride	2 ml
Methylated Spirit	10 ml
Acetone	to 20 ml

TO REMOVE GLASS STOPPERS FROM BOTTLES

Chloral Hydrate	55 0 Gm
Glycerine	22 0 ml
Hydrochloric Acid	27 0 ml
Water q s to make	100 0 ml

A few drops of the above solution are applied around the neck of the glass stopper, allowed to spread and to remain until the stopper can be removed by gentle rotation or tapping

LIST OF NORMAL BIOCHEMICAL VALUES

BLOOD

Alkali reserve, plasma bicarbonate = 55 to 70 vols CO_2 per cent
Volume of whole blood = 5 to 7 litres

Corpuscular volume (Hæmocrit) of whole blood = 40 to 45 per cent
Red blood corpuscles —
Men = 4 75 to 5 5 million per c mm
Women = 4 4 to 5 3 million per c mm
Leucocytes = 5,000 to 10 000 per c mm
Polymorphonuclears (neutrophils) = 50 to 70 per cent
Lymphocytes = 20 to 30 per cent
Platelets = 250,000 to 450 000 per c mm
Hæmoglobin (capillary blood)
Men = 13 to 16 Gm per 100 ml (95 to 120 per cent)
Women = 12 to 14 Gm per 100 ml (88 to 102 per cent)
Haldane Scale 100 per cent = 13 8 Gm of hæmoglobin

Hydrogen ion concentration = *pH* 7 3 to 7 5
Proteins (plasma) = 5 8 to 8 6 Gm per cent
Nitrogen, total (whole blood) = 2 6 to 4 3 Gm per cent
Nitrogen non protein = 25 to 50 mg per cent
Phosphorus total in plasma = 6 to 14 mg per cent
Phosphorus (inorganic) serum = 4 mg per cent
Calcium (serum) = 9 to 11 mg per cent
Calcium (inorganic) serum = 5 to 8 mg per cent
Sugar fasting (capillary blood) = 80 to 120 mg per cent
Sugar (maximum after a meal) = 180 mg per cent
Urea = 15 to 40 mg per cent
Creatinin = 0 5 to 1 5 mg per cent
Cholesterol = 150 to 250 mg per cent
Bilirubin (serum) = 0 1 to 0 25 mg per cent
Fibrinogen (plasma) = 0 22 *to* 0 36 *Gm per 100 ml*
Acid phosphatase (serum) = 1 to 4 King Armstrong units per 100 ml

Isotonic	Having the same osmotic pressure
Lateral	At the side
Lienorenal	Relating to the spleen and left kidney
Mucous (adjective)	Secreting mucus
Mucus (noun)	A clear viscid secretion from epithelial cells
Narcotic	Inducing drowsiness or stupor
Opiate	Made with or containing opium
Pathogenic	Causing disease
Periphery	External boundary
Plasma expander	A fluid which will increase the blood volume when given by intravenous infusion
Portocaval	Relating to the portal vein and the inferior vena cava
Premedication	Drugs given before an anæsthetic
Prodromal	That which forewarns
Pulse pressure	Difference between the systolic and diastolic blood pressures
Remittent	That which lessens at intervals without becoming normal
Sagittal	In line with the suture between the parietal bones of the skull
Saprophytic	Obtaining nourishment from decayed organic matter
Scirrhous	Hard (applied to tumours)
Sinus	A channel or tract
Sterile	Absence of all living organisms
Tumour	A swelling or growth

GLOSSARY

Acellular	Without cells
ACTH	Adrenocorticotrophic hormone
Ambulatory	Pertaining to walking
Amnesia	Loss of memory
Anæsthesia	Insensibility absence of sensation
Analeptic	Restorative
Analgesia	Absence of pain
Anastomosis	Connection between ducts, between blood vessels or between two loops of bowel
Ancillary	Subordinate
Aneurysm	Localized dilatation of an artery
Ankylosis	Fixation of a joint
Anoxia	Absence of oxygen
Antisepsis	Counteracting putrefaction
Apnœa	Absence of breathing
Asepsis	Absence of pathogenic bacteria
Asphyxia	Condition produced by interference with the oxygenation of the blood
Avirulent	Lacking in virulence
Bifurcation	Division into two branches
Bilateral	On or with two sides
Calculous (adjective)	Due to a calculus
Calculus (noun)	A stone or concretion in the body
Caries	Decay of bones or teeth
Coronal	In line with the suture between the frontal bone and the parietal bones of the skull
Curette	A small scraping instrument
Cystometer	An instrument for measuring the pressure in the bladder
Dextrose	Glucose
Dysfunction	Abnormal or incomplete function (of an organ)
Empyema	A cavity containing pus
Encephaloid	Resembling the brain
Epithelialization	Covering with epithelium
Extubation	Removal of a tube (from the larynx)
Fistula	A pipe like communication between two surfaces of the body external or internal
Hydration	*Replacement of water previously lost*
I M I	Intramuscular injection
Inhibit	Restrain or hinder
Intermittent	That which becomes normal at intervals
Intubation	Insertion of a tube (into the larynx)

Isotonic	Having the same osmotic pressure
Lateral	At the side
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Mucous (adjective)	Secreting mucus
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